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HOW DOES FINANCIAL LIBERALISATION AFFECT THE INFLUENCE OF MONETARY POLICY ON THE CURRENT ACCOUNT?

Ida Hjortsoe[(1)]
Martin Weale[(2)]
Tomasz Wieladek[(3)]

19th March 2018

Abstract
Does the current account improve or deteriorate following a monetary policy expansion? We examine this issue theoretically and empirically. We show that a standard open economy DSGE model predicts that the current account response to a monetary policy shock depends on the degree of financial regulation. In particular, financial liberalisation makes it more likely that the current account deteriorates following a monetary expansion. We test this theoretical prediction with a varying coefficient Bayesian panel VAR model, where the coefficients are allowed to vary as a function of the degree of financial, product and labour market regulation on data from 1976Q1-2006Q4 for 19 OECD countries. Our empirical results support the theory. We therefore conclude that following a monetary policy expansion, the current account is more likely to go into deficit in countries with more liberalised financial markets.

Keywords: Balance of Payments; Current Account; Bayesian Panel VAR; Economic Regulation; Monetary Policy.

***JEL* classification**: F32, E52, C11, C23.

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(1) Corresponding author. Research Hub, Bank of England, Threadneedle Street, EC2R 8AH London, United Kingdom, and CEPR. Email: ida.hjortsoe@bankofengland.co.uk
(2) King's College London. Email: martin.weale@kcl.ac.uk
(3) Barclays and CEPR. Email: tomaszwieladek@gmail.com

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1. Introduction

Does the current account improve or deteriorate following a monetary expansion? Neither theory nor empirical analysis offers a clear answer to this question, which is at the heart of the current debate about the international monetary system.[1] Papers which focus on the US such as Kim (2001a) or Barnett and Straub (2008) find that a US monetary loosening weakens the current account, while papers which consider a set of countries such as Kim (2001b) or Lee and Chinn (2006) find that an expansion of monetary policy tends to be followed by an improvement in the current account. This paper reconciles those findings by showing that the impact of monetary policy on the current account is likely to differ across countries and over time depending on certain economic features. In particular, our results suggest that the sign of the current account response following a monetary policy expansion depends on the degree of regulation in financial markets.

First, we show that the impact of monetary policy on the current account in an open economy DSGE model depends on the structural features of the economy, specifically the degree of regulation in financial markets. We examine how the channels through which monetary policy is transmitted to the current account are affected by regulation in financial markets. The model delivers predictions about the impact of liberalisation in financial markets on the current account response to monetary policy. We then use a Bayesian panel VAR to test those predictions. The coefficients in the VAR are allowed to vary stochastically as a function of the degree of regulation in different markets including financial markets, making it possible to estimate empirically the impact of financial regulation on the current account response to a monetary policy shock.

Our work expands on previous work analysing the effect of economic liberalisation on the monetary policy transmission mechanism by focusing on the open economy consequences of economic liberalisation and in particular on the implications for the current account. Work so far has not considered the effect of financial liberalisation on current account dynamics following monetary policy shocks but focused on domestic variables, see e.g. Iacoviello and Minetti (2003).

The DSGE model shows a number of routes by which monetary policy is transmitted to the current account. First, given prices, a temporary monetary expansion

[1] For example, King (2009) suggests that global imbalances were an important factor behind the global financial crisis of 2008/2009 and could have been addressed through global coordination of monetary policy.

induces people to bring forward consumption of imported as well as domestically produced goods (the import absorption channel). This leads to a deterioration of the current account by reducing net exports. Secondly, the consequent exchange rate depreciation makes domestic goods cheap relative to foreign goods and thus induces a rise in the consumption of the former relative to the latter (the expenditure switching channel). The resulting rise in net exports contributes to improving the current account. But the exchange rate depreciation also increases the cost of a given consumption basket and thus has a negative income effect which limits the increase in consumption of imported as well as domestic goods and thus contributes positively to the current account (the purchasing power channel). Finally, to the extent international financial markets lead to some degree of consumption risk sharing across countries, and thus to portfolio diversification, the domestic monetary shock will also affect the rest of the world, leading to some increase in consumption abroad. A current account improvement will result (the portfolio diversification channel). The model shows that which of those channels dominate, and therefore whether the current account improves or deteriorates following a monetary expansion, depends on the structure of the economy considered (characterised *inter alia* by the degree of regulation in financial markets).

We investigate how the degree of financial market liberalisation affects the transmission of monetary policy to the current account within the DSGE model, by comparing economies which are tightly regulated with those which are lightly regulated. In our model, the degree of financial regulation is captured by the proportion of households without access to financial markets, consistent with empirical evidence suggesting that financial liberalisation reduces the fraction of liquidity-constrained consumers in an economy. We vary this measure of regulation and consider the impact on the impulse responses following a monetary policy shock.

The DSGE model predicts that financial liberalisation affects the monetary policy transmission and its consequences for the current account. It amplifies the import absorption channel, so that financial liberalisation means that the current account is more likely to deteriorate after a monetary expansion. This result holds for a wide range of plausible structural parameter values.

We use VAR analysis to test the prediction of our theoretical model regarding the impact of financial regulation on the transmission of monetary policy. In particular, we use a varying coefficient panel VAR model in which we allow the coefficients to vary with the degree of regulation in different markets including in financial markets. We carefully match the statistical measure for financial regulation to our measure in the theoretical model.

In principle we could test the predictions country by country. A number of authors have used VAR frameworks to look at the implications of economic liberalisation by only exploiting time-series variation. An alternative approach has been to look at cross-sectional variation. If there are countries with similar characteristics, pooling by characteristic may offer a means of determining the structure within those countries better. But if the regulatory changes in question can be quantified in the form of a country-specific and time-varying index, it may appear desirable to estimate a model in which account is taken of both types of variation. Wieladek (2016) proposes a Bayesian shrinkage approach to estimate panel VAR models where the coefficients are a stochastic function of several exogenous variables. The structure resulting from Bayesian shrinkage permits random parameter variation both across countries and over time. Since this approach allows for both stochastic variation and multiple structural characteristics, this is the econometric approach that we choose to follow. It delivers a random effects estimator.

The advantage of this econometric approach is that we can formally test the implications of our theoretical model by comparing the distributions of impulse responses in the presence of high and low degrees of regulation in financial markets, while controlling for changes in the degree of regulation in other markets, thereby reducing omitted variable bias. That makes it easy to understand whether and how financial liberalisation has affected the monetary policy transmission to the current account over time. Monetary policy shocks are identified with sign restrictions (See Canova and De Nicolo (2002); Uhlig (2005); Faust and Rogers (2003)), derived from our DSGE model. To ensure robustness to the type of identification, we also examine monetary policy shocks identified with lower-triangular zero restrictions, with consumption and the consumer price index ordered before the short-term interest rate (as in Christiano, Eichenbaum and Evans (1999)).

To our knowledge we are the first to test formally the open economy consequences of a rich body of monetary theory which implies that the reaction of variables to a monetary policy shock should depend on the structural characteristics of the economy considered. By the standards of previous work that studies how changes to structural characteristics affect the transmission mechanism, our econometric methodology allows us to account for a larger number of structural characteristics. As these variables are likely to be correlated, this should reduce the scope for omitted variable bias to produce misleading results.

Our empirical results confirm the DSGE model predictions of the impact of financial liberalisation: the magnitude of the current account response is highly dependent on the financial market regime. Financial liberalisation leads to a greater current account deficit in response to the same size monetary policy expansion. As a result, the current account is more likely to deteriorate in economies with highly liberalised financial markets.

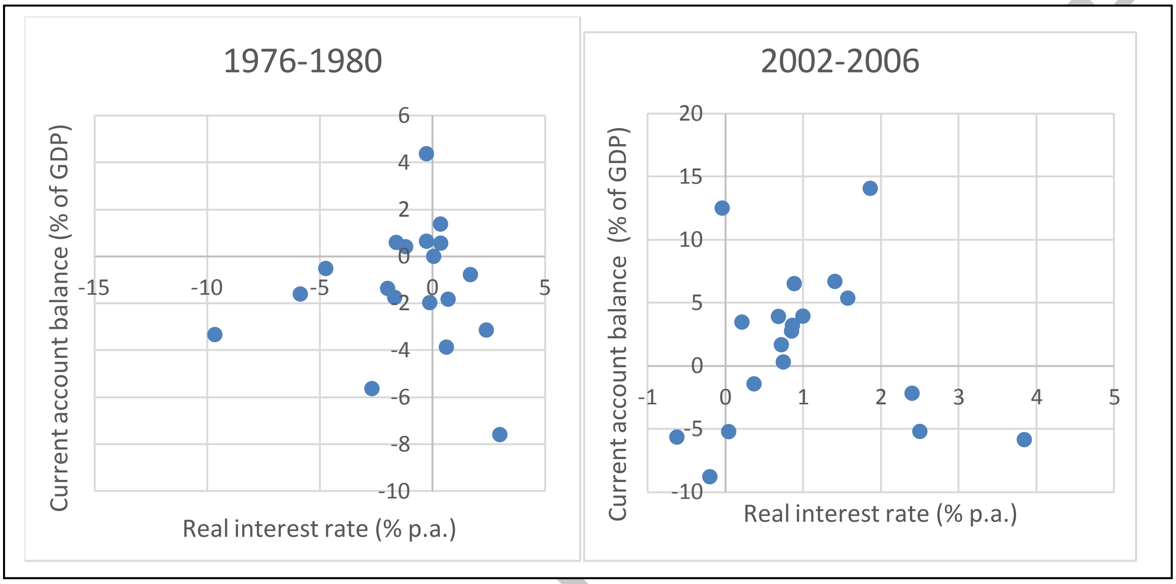
Our findings have important implications for understanding the impact of economic policy on the current account. Our results suggest that if policy makers set policy with some reference to the current account, they need to take into account the structure of the economy and in particular the extent of regulation in financial markets.

The focus of the paper can be seen in Figure 1. We plot, in the left-hand panel the average of the current account balance to GDP against the average real interest for the nineteen OECD economies we consider, for the period 1976-1980[2]. The right-hand panel shows the same variables for the period 2002-2006. Looking at the full data set there is no correlation present in either chart. But the chart for 2002-2006 shows three clear outliers, in the bottom right-hand part of the graph; these are the data points for Australia, New Zealand and the United Kingdom. The remaining observations show a strong positive correlation between the current account surplus and the real interest rate. To the extent that the latter is an indicator of the monetary stance the data suggest that, in the 1970s some countries recorded current account surpluses in response to monetary tightening, while others recorded deficits. On the other hand, in the 2000s, most countries recorded surpluses in response to monetary tightening, which is consistent with the income-absorption effect dominating the expenditure switching effect of adjustment. This discrepancy could be because in the 1970s only some countries were financially liberalised, while by the 2000s most countries converged to the same high level of

[2] Our data are explained more fully at the start of section 3.

financial liberalisation. While the evidence of the graph is only tenuous, it illustrates the point that we investigate.

Figure 1. The current account and the real interest rate



The remainder of the paper is structured as follows: Section 2 presents the theoretical model as well as our theoretical results. Section 3 describes our empirical methodology, the data, and our empirical results. Section 4 discusses how the theoretical and empirical results can be reconciled and concludes.

2. Theoretical Results

2.1. The model

The framework we use to investigate the impact of monetary policy on the current account is a standard open-economy DSGE model. It builds on the framework used in Eggertson et al (2014) by incorporating features present in other DSGE models such as the SIGMA model developed by Erceg et al (2006). Our model consists of a world composed of two countries, denoted H (Home) and F (Foreign). There are respectively n and 1-n households in each of these countries. There are two types of households in each country: households who have access to the financial markets and that we name Ricardian or optimizing households (indicated with superscript O); and households who do not have access to financial markets and are therefore constrained to consume their entire income in every period. We name the latter households rule of thumb households (denoted with superscript R).[3] While Ricardian consumers face complete financial markets at the domestic level, international financial markets are incomplete in that only nominal bonds are traded internationally. Ricardian households supply differentiated labour inputs and set wages in a staggered fashion, whereas rule-of-thumb households decide on their labour supply taking wages as given.[4] Firms use these labour inputs to produce differentiated traded and non-traded goods and set prices in a staggered fashion. In what follows, we present the behaviour of agents in the Home country, but analogous relations hold for agents in the Foreign country, unless otherwise specified.

2.1.1. Firms

As in Eggertson et al (2014), firms produce differentiated goods and operate either within the traded goods sector (producing good $k = H$) or within the non-traded goods sector (producing good $k = N$). Firms are monopolistically competitive and set prices in a staggered fashion $\dot{a}$ la Calvo-Yun. That is, firms reset their price at a time-independent random frequency. More specifically, each firm faces the probability 1-α_H^k of being able to reset its price in each period. Firms are owned by domestic Ricardian households. Technology is linear in labour, and output of domestic firm h in sector k is $y_{k,t}(h) = l_{k,t}(h)$. In Appendix B, we discuss how the model changes when we include capital as a factor of production and show that our main results are not affected.[5]

The differentiated goods produced in country H are assembled into composite traded and non-traded consumption goods by using a Dixit-Stiglitz aggregator.

$$Y_{k,t} = \left[\left(\frac{1}{a_H^k}\right)^{\frac{1}{\theta_H}} \int_0^{a_H^k} y_{k,t}\,(h)^{\frac{\theta_H - 1}{\theta_H}} dh\right]^{\frac{\theta_H}{\theta_H - 1}}$$

[3] We here follow the literature, e.g. Gali, Lopez-Salido and Valles (2004)

[4] This simplification ensures that the average wage is the same for the two types of households and is also made in Erceg et al (2006).

[5] The robustness of our model to this extension is particularly important given Backus, Kehoe and Kydland (1994)'s analysis of trade balance dynamics. They find that in the face of productivity shocks, only a model which includes capital can replicate the observed behaviour of the trade balance. While they also consider government spending shocks, they do not consider the effects of monetary policy shocks on the trade balance, as we do here.

where $a_H^N = 1 - a_H^H$ is the size of the non-traded goods sector relative to the traded goods sector within country H, and θ_H denotes the elasticity of substitution between the differentiated goods produced within country H. The part of the traded consumption good, which is consumed in the domestic market is denoted $C_{H,t}$, while the part which is consumed in the Foreign market (i.e. exported) is denoted $C_{H,t}^*$.

The optimisation problem of the firm producing good h in sector k and getting the opportunity to reset its price at time t consists of choosing a price $p_{k,t}(h)$ so as to maximize expected discounted future profits:

$$\max_{p_{k,t}(h)} E_t \sum_{s=0}^{\infty} {\alpha_H^k}^s \mu_{t,t+s} \left[\left((1-\tau_H^k)p_{k,t}(h) - \frac{W_{k,t+s}}{P_{t+s}}\right) y_{k,t,t+s}(h)\right]$$

where E_t is the expectations operator, $\mu_{t,t+s}$ is the stochastic discount factor of the firm, and τ_H^k is a tax on sales applied to sector k. W_k is the nominal wage in sector k while P is the consumption price level. $y_{k,t,t+s}(h)$ is the demand at time $t+s$ for good h produced in sector k at the price $p_{k,t}(h)$. Given that firms are owned by the Ricardian households their stochastic discount factor is identical to the stochastic discount factor of the representative Ricardian household: $\mu_{t,t+s} = \beta^s \left({U_{C,t+s}^O}/{U_{C,t}^O} \right) \left({P_t}/{P_{t+s}} \right)$, where β is the households' discount factor and $U_{C,t}^O$ is the Ricardian households' marginal utility from consumption in period t, whereas P_t is the consumer price index.

The resulting first order conditions imply that prices are set according to expectations of future marginal costs and demand in the following way:

$$p_{k,t}(h) = \frac{\theta_H^k}{(\theta_H^k - 1)(1-\tau_H^k)} \frac{E_t \sum_{s=0}^{\infty} (\beta\alpha_H^k)^s U_{C,t+s}^O \frac{W_{k,t+s}}{P_{t+s}} y_{k,t,t+s}(h)}{E_t \sum_{s=0}^{\infty} (\beta\alpha_H^k)^s P_{t+s}^{-1} U_{C,t+s}^O y_{k,t,t+s}(h)}$$

Because all sector k firms that get to reset their price in a given period face the same expectations of marginal costs and demand, they all set the same price. Hence, the price level in sector k, P_k, is given by

$$P_{k,t} = \left[\alpha_H^k P_{k,t-1}^{1-\theta_H^k} + (1-\alpha_H^k) p_{k,t}(h)^{1-\theta_H^k}\right]^{\frac{1}{1-\theta_H^k}}$$

Aggregating output across firms yields $Disp_{k,t}Y_{k,t} = L_{k,t}$ where $Disp_{k,t} \equiv \int_0^n \left(\frac{p_{k,t}(h)}{P_{k,t}}\right)^{-\theta_H^k} dh \geq 1$ is a measure of the degree of price dispersion in sector k. The price setting process of firms introduces a distortion as it causes price dispersion among firms with identical technologies.

2.1.2. Households

A proportion, $1-\lambda_H^R$ of households are Ricardian, with λ_H^R following a rule of thumb in the Home country. Both types of households ($i = O$ and $i = R$) get utility from private consumption (c^i) but disutility from working in the non-traded goods sector (l_N^i) and in the traded goods sector (l_H^i), and household i's welfare is given by

$$W_0^i = E_0 \sum_{t=0}^{\infty} \beta^t \{U^c(c_t^i) - \kappa[U^l(l_{N,t}^i) + U^l(l_{H,t}^i)]\}, \quad i = \{O,R\}$$

where E_t denotes the expectations at time t, β is the discount factor, and κ is a parameter determining the weight put on labour vs consumption fluctuations in affecting utility. The functional forms are as follows:

$$U^c(c_t^i) = \frac{c_t^{i1-\sigma_H}}{1-\sigma_H}$$
$$U^l(l_{k,t}^i) = \frac{l_{k,t}^{i1+\eta_H}}{1+\eta_H}, \qquad k = \{H,N\}$$

where $\sigma_H > 0$ is the inverse of the inter-temporal elasticity of substitution and the relative risk aversion coefficient, and $\eta_H > 0$ is the inverse of the Frisch labour supply elasticity. We assume that the disutility from working in either sector is the same.

Household i's consumption of traded goods is a CES index of the composite traded good produced at Home for the Home market, C_H, and the composite traded good produced in the Foreign country for the Home market, C_F:

$$C_{T,t}^i = \left[a_H^{\frac{1}{\varphi_H}} C_{H,t}^{i\frac{\varphi_H-1}{\varphi_H}} + (1-a_H)^{\frac{1}{\varphi_H}} C_{F,t}^{i\frac{\varphi_H-1}{\varphi_H}}\right]^{\frac{\varphi_H}{\varphi_H-1}}, 0 < a_H < 1, \varphi_H > 0, i = \{O,R\}$$

where the constant elasticity of substitution between the home and foreign traded goods is denoted φ_H. a_H is the weight given to consumption of the composite Home traded good and is defined as $a_H \equiv 1-(1-n)op$ where op is a measure of openness. Similarly,

$1 - a_H \equiv (1-n)op$ is the weight attached to consumption of the composite Foreign traded good. If $op < 1$ so that $a_H > n$, then a home bias in traded consumption is present.

Households choose their relative traded consumption demand such as to maximize utility for given expenditures. The resulting domestic demand for respectively Home and Foreign traded goods is:

$$C^i_{H,t} = a_H \left(\frac{P_{H,t}}{P_{T,t}}\right)^{-\varphi_H} C^i_{T,t}, \qquad i = \{O, R\}$$

$$C^i_{F,t} = (1-a_H)\left(\frac{P_{F,t}}{P_{T,t}}\right)^{-\varphi_H} C^i_{T,t}, \qquad i = \{O, R\}$$

where P_H and P_F respectively denote the price of the domestically produced generic traded good C_H and the foreign traded good C_F in domestic currency, whereas P_T denotes the price of the domestic traded consumption basket C_T.

Traded and non-traded goods are assembled into a final consumption basket by using a CES aggregator with elasticity of substitution φ^N_H

$$C^i_t = \left[a^{H\,\frac{1}{\varphi^N_H}}_H C^{i\,\frac{\varphi^N_H - 1}{\varphi^N_H}}_{T,t} + (1-a^H_H)^{\frac{1}{\varphi^N_H}} C^{i\,\frac{\varphi^N_H - 1}{\varphi^N_H}}_{N,t} \right]^{\frac{\varphi^N_H}{\varphi^N_H - 1}}, 0 < a^H_H < 1, \varphi^N_H > 0, i = \{O, R\}$$

Domestic demand for traded and non-traded goods respectively, resulting from maximising consumption for given expenditures is:

$$C^i_{T,t} = a^H_H \left(\frac{P_{T,t}}{P_t}\right)^{-\varphi^N_H} C^i_t, \quad i = \{O, R\}$$

$$C^i_{N,t} = (1-a^H_H)\left(\frac{P_{N,t}}{P_t}\right)^{-\varphi^N_H} C^i_t, \quad i = \{O, R\}$$

where P_N denotes the price of the non-traded consumption good C_N in domestic currency, whereas P denotes the price of the domestic consumption basket C. Note that because preferences are identical across domestic households and they face the same price, the composition of their consumption baskets will be identical.

The consumption-based price indices are defined analogously to the consumption bundles

$$P_t = \left[a_H^H P_{T,t}^{1-\varphi_H^N} + (1-a_H^H) P_{N,t}^{1-\varphi_H^N}\right]^{\frac{1}{1-\varphi_H^N}}$$

$$P_{T,t} = \left[a_H P_{H,t}^{1-\varphi_H} + (1-a_H) P_{F,t}^{1-\varphi_H}\right]^{\frac{1}{1-\varphi_H}}$$

where

$$P_{H,t} = \left[\frac{1}{a_H^H}\int_0^{a_H^H} p_t\,(h)^{1-\theta_H} dh\right]^{\frac{1}{1-\theta_H}}, P_{F,t} = \left[\frac{1}{a_F^F}\int_0^{a_F^F} p_t\,(f)^{1-\theta_F} dh\right]^{\frac{1}{1-\theta_F}},$$

$$P_{N,t} = \left[\frac{1}{1-a_H^H}\int_0^{1-a_H^H} p_t\,(h)^{1-\theta_H} dh\right]^{\frac{1}{1-\theta_H}}$$

where a_F^F denotes the relative size of the traded sector in country F. The terms of trade are defined as the ratio between the price of imports and exports: $TOT_t \equiv \frac{P_{F,t}}{P_{H,t}}$, whereas the real exchange rate is defined as the price of the Foreign consumption bundle in terms of the Home consumption good: $Q_t \equiv \frac{s_t P_t^*}{P_t}$ where s_t is the nominal exchange rate and a starred variable denotes a Foreign variable: P_t^* is the Foreign consumer price index. We assume that the law of one price holds: $p_t(f) = s_t p_t^*(f) \Rightarrow P_{F,t} = s_t P_{F,t}^*$ and similarly for import prices in country F.

Ricardian households

Every period, domestic Ricardian households choose consumption and bond holdings to maximize their expected discounted stream of future utility subject to their budget constraint and their labour income. They face complete financial markets at the domestic level: they own an equal share in every domestic firm and profits are therefore equally distributed among the Ricardian domestic households. Ricardian households also have access to the international financial markets, but these are incomplete: only nominal one-period bonds denominated in Foreign currency are traded across countries. The interest on these internationally traded bonds depends on the Foreign interest rate and the level of external debt: the yields of the bonds are increasing in external debt as in Schmitt-Grohe and Uribe (2003). Apart from implying stationarity of the steady state, modelling financial frictions through a debt-elastic yield on bonds allows for state-contingent yield differences across countries.

Every period, Ricardian households use their labour income, wealth accumulated in domestic and foreign bonds (denominated in Foreign currency), and profits of firms in the domestic economy (PR) to purchase consumption and both domestically issued bonds (B_H) and Foreign bonds (B_F) and pay lump-sum taxes. In the Home country, the representative Ricardian household budget constraint thus amounts to:

$$C_t^O + \frac{B_{H,t}}{P_t(1+i_t)} + \frac{s_t B_{F,t}}{P_t(1+i_t^*)\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)} + T_t$$
$$= \left(1-\tau_{H,H}^w\right)\frac{W_{H,t}}{P_t}L_{H,t}^O + \left(1-\tau_{N,H}^w\right)\frac{W_{N,t}}{P_t}L_{N,t}^O + \frac{B_{H,t-1}}{P_t} + \frac{s_t B_{F,t-1}}{P_t} + PR_t$$

where C_t^O is consumption of the representative Ricardian household, i_t is the nominal interest rate set by the Home central bank in period t and defines the return on domestically issued bonds denominated in the Home currency (B_H), and i_t^* is the nominal interest set by the Foreign central bank in period t, $W_{k,t}$ is the nominal wage rate in sector k, and $L_{k,t}^O$ is the hours worked in sector k, PR_t denote profits made by domestic firms, $\tau_{k,H}^w$ is the labour income tax rate in sector k, T_t denotes lump-sum taxes paid by the household, and $B_{F,t}$ is the nominal holdings of Foreign bonds (denominated in Foreign currency).

The function Φ is assumed to depend positively on deviations of external debt from its steady state level, $\Phi'(\cdot) < 0$, and satisfies $\Phi\left(\frac{sB_F}{P}\right) = 1$ in steady state. We specify the yield premium associated with holding bonds to be linear in deviations of borrowing/lending from steady state: $\Phi(b_t) = 1 - \delta(b_t - \frac{B}{P})$, with $\delta > 0$ and $\frac{B}{P} = \frac{sB_F}{P}$. Note that because $\Phi'(\cdot) < 0$, whenever B_F is low[6], then the yield on debt is high ($\Phi(\cdot) > 1$). On the contrary, when bond holdings are high implying that Home households have claims on Foreign households, then $\Phi(\cdot) < 1$ and the price of bonds is high and purchasing even more bonds is expensive. For simplicity, we assume that individual households do not internalize the effect of changes in their own bond holdings on the yield, i.e. they take the function $\Phi(\cdot)$ as given.

[6] i.e. when external debt is high in the Home country

The first-order conditions of the representative Ricardian domestic household's maximisation problem with respect to consumption and bond holdings can be aggregated to yield:

$$\beta E_t \frac{C_{t+1}^{O-\sigma}}{C_t^{O-\sigma}} \frac{(1+i_t)}{\pi_{t+1}} = 1$$

$$\beta E_t \frac{C_{t+1}^{O-\sigma}}{C_t^{O-\sigma}} \frac{(1+i_t^*)}{\pi_{t+1}^*} \frac{Q_{t+1}}{Q_t} = \frac{1}{\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)}$$

where $\pi_t \equiv \frac{P_t}{P_{t-1}}$ and $\pi_t^* \equiv \frac{P_t^*}{P_{t-1}^*}$ denote CPI inflation respectively in the Home and in the Foreign country, and $Q_t \equiv \frac{s_t P_t^*}{P_t}$ is the real exchange rate. These Euler equations, determining the inter-temporal allocation of domestic Ricardian consumption, result from the first order condition with respect to domestic bond holdings and Foreign bond holdings.[7]

Ricardian agents supply differentiated labour inputs to each sector ($\theta_{k,H}^w$ is the elasticity between different labour inputs in sector k) and set wages in a staggered fashion. In particular, they get to renegotiate their wage $w_{k,t}$ in sector k with the same probability $1-\alpha_{k,H}^w$ every period. When they do renegotiate their wage they set it so as to maximise their expected discounted stream of future utility subject to the demand for their labour, as determined by the wage elasticity. The optimality condition implies the following wage setting equation in sector k:

$$\left(\frac{w_{k,t}}{W_{k,t}}\right)^{1+\theta_{k,H}^w} = \frac{\theta_{k,H}^w}{\theta_{k,H}^w - 1} \frac{E_t \sum_{s=0}^{\infty} (\beta \alpha_{k,H}^w)^s \left(\frac{L_{k,t+s}^O}{a_H^k}\right)^{1+\eta_H} {\pi_{k,t+s}^w}^{\theta_{k,H}^w(1+\eta_H)}}{E_t \sum_{s=0}^{\infty} (\beta \alpha_{k,H}^w)^s (1-\tau_k^w) \left(\frac{L_{k,t+s}^O}{a_H^k}\right) C_{t+s}^{O-\sigma} {\pi_{k,t+s}^w}^{\theta_{k,H}^w - 1}}, k = H, N$$

Because all Ricardian households that reset their sector k wage in a given period face the same expectations of marginal disutility and demand, they all set the same wage. Hence, the wage level in sector k, W_k, is given by

[7] Note that the Foreign Ricardian household only faces one Euler equation as it holds only its own internationally traded bonds. This assumption can be justified by the fact that most small open economies have the majority of their international debt denominated in the currency of a larger economy. Allowing for international trade in a second bond denominated in the Home currency would not change the results.

$$W_{k,t} = \left[\alpha_{k,H}^{w} W_{k,t-1}^{1-\theta_{k,H}^{w}} + (1-\alpha_{k,H}^{w}) w_{k,t}(h)^{1-\theta_{k,H}^{w}}\right]^{\frac{1}{1-\theta_{k,H}^{w}}}$$

Rule of thumb households

Rule of thumb households do not have access to financial markets and take wages set by Ricardian households as given.[8] They choose consumption and labour supply to maximize their expected discounted stream of future utility subject to their budget constraint $P_t C_t^R = W_{H,t} L_{H,t}^R + W_{N,t} L_{N,t}^R$. The first-order conditions of the representative rule of thumb household can be aggregated to yield:

$$\frac{\left(\frac{L_{k,t}^R}{a_H^k}\right)^{\eta_H}}{C_t^{R-\sigma}} = \frac{W_{k,t}}{P_t}, \qquad k = H, N$$

Using the budget constraint, we get

$$C_t^R = \left[a_H^H \left(\frac{W_{H,t}}{P_t}\right)^{\frac{1+\eta_H}{\eta_H}} + (1-a_H^H)\left(\frac{W_{N,t}}{P_t}\right)^{\frac{1+\eta_H}{\eta_H}}\right]^{\frac{\eta_H}{\eta_H+\sigma_H}}$$

Aggregation

Aggregating across households, Home labour supply in sector k amounts to

$$L_{k,t} = (1-\lambda_H^R) L_{k,t}^O + \lambda_H^R L_{k,t}^R$$

Similarly, aggregating demand for goods across households implies that

$$C_t = (1-\lambda_H^R) C_t^O + \lambda_H^R C_t^R$$

2.1.3. Fiscal policy

Labour income and sales taxes are fixed to ensure that the steady state is efficient:

[8] This assumption is also used in Erceg et al (2006) and ensures that the average wage is identical across household types. Our results are not materially affected if the rule-of-thumb households have a fixed instead of endogenous labour supply. These are available on request.

$$\tau_H^k = \frac{1}{1-\theta_H^k}, \qquad k = H, N$$

$$\tau_{k,H}^w = \frac{1}{1-\theta_{k,H}^w}, \qquad k = H, N$$

The government is assumed to balance its budget every period implying that the taxes it levies on Ricardian households and firms are redistributed back to them through lump sum transfers.

$$-T_t = \tau_{H,H}^w \frac{W_{H,t}}{P_t} L_{H,t}^O + \tau_{N,H}^w \frac{W_{N,t}}{P_t} L_{N,t}^O + \tau_H^H P_{H,t} Y_{H,t} + \tau_N^H P_{N,t} C_{N,t}$$

2.1.4. Monetary policy

We abstract from monetary frictions and can thus consider a "cashless economy" as in Woodford (2003). The domestic monetary policy instrument is the nominal interest rate paid on one-period bonds, denoted i. The monetary policy authority sets the interest rate on domestic bonds with the aim of stabilizing domestic CPI inflation and smooth interest rate changes as well as targeting the nominal exchange rate. In particular, the Home monetary authority follows a rule of the following form:

$$\log\left(\frac{1+i_t}{\bar{\imath}}\right) = (1-\alpha_H^{FIX})\left[\alpha_H^R \log\left(\frac{1+i_{t-1}}{\bar{\imath}}\right) + \alpha_H^\pi \log\left(\frac{\pi_t}{\bar{\pi}}\right)\right] + \alpha_H^{FIX} \log\left(\frac{(1+i_t^*)\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)}{\bar{\imath}}\right) + \psi_t^I$$

where $1-\alpha_H^{FIX}$ indicates the amount of exchange rate flexibility in the Home country. If $\alpha_H^{FIX} = 0$, then monetary policy is not constrained by exchange rate stabilization.[9] $(1-\alpha_H^{FIX})\,\alpha_H^\pi$ indicates the weight put on stabilizing CPI inflation, and $(1-\alpha_H^{FIX})\alpha_H^R$ indicates the relative weight put on interest rate smoothing. ψ_t^I is a monetary policy

[9] If instead, $\alpha_H^{FIX} = 1$, then the monetary authority ensures a fixed exchange rate. Indeed, the Home consumption Euler equations imply that $\beta E_t \frac{C_{t+1}^{O-\sigma}}{C_t^{O-\sigma}} \frac{(1+i_t)}{\pi_{t+1}} = \beta E_t \frac{C_{t+1}^{O-\sigma}}{C_t^{O-\sigma}} \frac{(1+i_t^*)}{\pi_{t+1}^*} \frac{Q_{t+1}}{Q_t} \Phi\left(\frac{s_t B_{F,t}}{P_t}\right)$ so that $(1+i_t) = (1+i_t^*)\frac{s_{t+1}}{s_t}\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)$. To ensure a fixed exchange rate ($\frac{s_{t+1}}{s_t} = 1$), the monetary policy makers must set the interest rate according to $(1+i_t) = (1+i_t^*)\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)$, i.e. $\log\left(\frac{1+i_t}{\bar{\imath}}\right) = \log\left(\frac{(1+i_t^*)\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)}{\bar{\imath}}\right)$.

shock.[10] The Foreign monetary authority follows an analogous monetary policy rule. Monetary policy affects the real economy in the presence of nominal rigidities, and through its effect on the debt burden of countries.

2.1.5. Market clearing and aggregation

Aggregate demand facing domestic producers of traded goods amounts to:

$$Y_{H,t} = a_H \left(\frac{P_{H,t}}{P_{T,t}}\right)^{-\varphi} C_{T,t} + \frac{1-n}{n}(1-a_F)\left(\frac{P_{H,t}}{P_{T,t}}\right)^{-\varphi}\left(\frac{s_t P^*_{T,t}}{P_{T,t}}\right)^{\varphi} C^*_{T,t}$$

and aggregate demand for foreign traded goods amounts to:

$$Y_{F,t} = \frac{n}{1-n}(1-a_H)\left(\frac{P^*_{F,t}}{P^*_{T,t}}\right)^{-\varphi}\left(\frac{s_t P^*_{T,t}}{P_{T,t}}\right)^{-\varphi} C_{T,t} + a_F\left(\frac{P^*_{F,t}}{P^*_{T,t}}\right)^{-\varphi} C^*_{T,t}$$

Output is demand-determined in equilibrium, and, hence, the above equations can also be viewed as goods market clearing conditions.

Aggregate output in country H amounts to

$$Y_t = \left(\frac{P_{H,t}}{P_t}\right) Y_{H,t} + \left(\frac{P_{N,t}}{P_t}\right) C_{N,t}.$$

Equilibrium in the financial markets requires that bonds and assets issued in the Home economy are in zero net supply within the domestic economy,

$$B_{H,t} = 0,$$

and that internationally traded bonds issued in Foreign currency by the Foreign country are in zero net supply:

$$nB_{F,t} + (1-n)s_t B^*_{F,t} = 0$$

where $B^*_{F,t}$ denotes Foreign holdings of the Foreign bond.

An aggregate resource constraint for each country can be obtained by combining the households' budget constraints, the government budget constraint and the bond

[10] Given that we are only interested in studying the impact of monetary policy shocks in this model, we do not introduce other shocks for the purpose of this analysis.

market equilibrium conditions:

$$C_t + \frac{Q_t \frac{B^*_{F,t}}{P^*_t}}{P_t(1+i^*_t)\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)} = Y_t + \frac{Q_t \frac{B^*_{F,t-1}}{P^*_{t-1}}}{\pi^*_t}$$

This constraint characterizes the evolution of the current account balance. We define the current account balance as the change in real Foreign bond holdings:[11]

$$CA_t \equiv \frac{B_{F,t}}{P_t} - \frac{B_{F,t-1}}{P_{t-1}}$$

2.1.6. Parameterization

In our theoretical analysis of the transmission of monetary policy we do not restrict ourselves to a specific set of model parameter values, as we want to ensure that our conclusions are not dependent on the particular structural features of the model. Therefore we consider a range for each of the structural parameters in our model simulations. In particular, in order to examine the impact of a monetary policy shock, we simulate the model in response to that shock many times, each time choosing different parameter values from the specified ranges, assuming that the parameters are independently and uniformly distributed over those ranges. As a result of these simulations, we get a distribution of impulse responses to a monetary policy shock which reflects different economic structures.

The parameter ranges are shown in Table 1. The model is calibrated at a quarterly frequency. For simplicity, we fix some parameters: the size of the Home country constitutes 10 percent of the World, the quarterly discount factor ensures a steady state annual interest rate of 4 percent, and the yield sensitivity to debt is fixed to 0.01 such that the annual yield increases by 0.01 percentage point for every 1 percent increase in external debt.[12] We allow all other Home and Foreign parameters to take on values

[11] We can rewrite this definition as:

$$CA_t \equiv \frac{Q_t \frac{B^*_{F,t}}{P^*_t}}{P_t} - \frac{Q_t \frac{B^*_{F,t-1}}{P^*_{t-1}}}{\pi^*_t}$$

[12] We fixed the size of the country as we are not interested in understanding how the size of countries affects the transmission. A non-zero yield sensitivity ensures that the model is stationary and determines the pace with which the current account returns to steady state. Our results are not sensitive to changes in that parameter.

within a relatively broad range, and we do not restrict those parameters to be identical across countries. The degree of openness is allowed to take on any value between 20 and 40 percent, the elasticity of labour supply between 0.4 and 0.7, and the risk aversion coefficient between 1 and 1.2. Both prices and wages within each sector are sticky, but the degree of stickiness and associated monopoly powers are allowed to take on values ranging widely.

The elasticity of substitution between traded goods takes values between 0.5 and 1. The lower end of the range encompasses methods of moments estimates by Corsetti et al (2008) as well as time series estimates by Hooper et al (2000), whereas the upper end of the range encompasses the estimate found by Heathcote and Perri (2002), and calibration used by Stockman and Tesar (1995). The traded goods are substitutes in the Pareto-Edgeworth sense when the trade elasticity is higher than the inter-temporal elasticity ($\phi_H > \frac{1}{\sigma_H}$), so the chosen range ensures that the traded goods can be either complements or substitutes.[13] The elasticity of substitution between traded and non-traded goods can take on values between 0.4 and 1, consistent with evidence provided by Stockman and Tesar (1995) or Mendoza (1992).

The proportion of rule-of-thumb households takes on values between 10 and 40 percent, based on evidence pointed out in Section 2.3 below. Finally, we allow for different degrees of persistence and inflation targeting in the central bank's rule, and potentially some degree of exchange rate targeting.

Table 1. Parameter ranges

Description	Parameter	Range
Population in Home country	n	0.1
Discount factor	β	0.99
Yield sensitivity to external debt	δ	0.01
Home/Foreign country parameters:		
Degree of openness	op_H, op_F	[0.2,0.4]
Inverse of the Frisch elasticity of labour supply	η_H, η_F	[1.5,2.5]
Risk aversion coefficient	σ_H, σ_F	[1,1.2]
Price stickiness parameter in sector k	α_H^k, α_F^k	[0.25,0.9]
Wage stickiness parameter in sector k	$\alpha_{k,H}^w, \alpha_{k,F}^w$	[0.25,0.9]
Intra-temporal elasticity of substitution in sector k	θ_H^k, θ_F^k	[3,11]
Elasticity of substitution between labour inputs in sector k	$\theta_{k,H}^w, \theta_{k,F}^w$	[3,11]
Elasticity of substitution between traded H and F goods	ϕ_H, ϕ_F	[0.5,1]
Elasticity of substitution between traded and non-traded goods	φ_H^N, φ_F^N	[0.4,1]

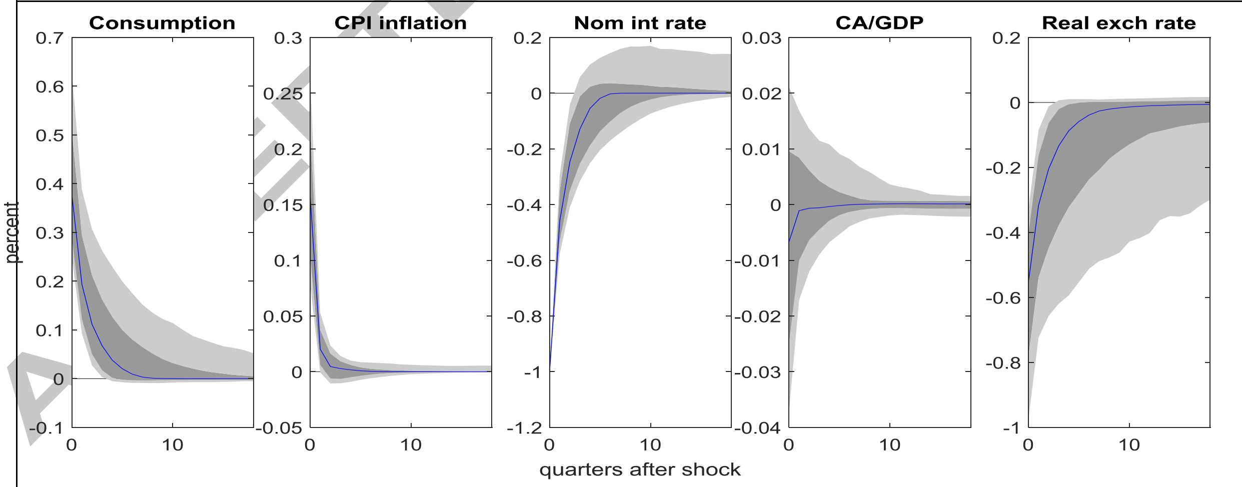
[13] For a detailed analysis of the importance of substitutability for the international transmission of shocks see Corsetti et al (2010).

Proportion of rule of thumb households	λ_H^R, λ_F^R	[0.1,0.4]
<u>Home/Foreign monetary policy rule parameters:</u>		
Interest rate persistence	α_H^R, α_F^R	[0.5,0.9]
Interest rate sensitivity to CPI inflation	$\alpha_H^\pi, \alpha_F^\pi$	[1.2,3]
Degree of exchange rate targeting	$\alpha_H^{FIX}, \alpha_F^{FIX}$	[0,0.3]

2.2. The transmission of monetary policy to the current account

A one percentage point fall in the nominal interest rate in the DSGE model described leads to an increase in consumption, CPI and a real exchange rate depreciation, in line with standard DSGE models. This is illustrated in Figure 2 below which shows the impulse response functions of selected variables to a one percentage point fall in the nominal interest rate. The impulse responses are computed by solving the model a thousand times, each time drawing all the parameters randomly from a uniform distribution over the parameter ranges specified in Table 1. Figure 2 reports the median impulse response from the thousand simulations in blue as well as the central 90 and 68 percent of the distribution of impulse responses (in different shades).

Figure 2: Impact of a monetary policy expansion



Note: Figure 2 shows the effect of an unexpected monetary policy expansion corresponding to a 100 basis point fall in the nominal interest rate. The subplots show the impulse responses following the monetary expansion of real consumption, the CPI inflation rate, the nominal interest rate, the current account to GDP ratio and the real exchange rate, with all parameter values randomly selected from a uniform distribution over the parameter ranges specified in Table 1. For all variables percentage deviations from steady state are depicted, except for the annual nominal interest rate and the current account to GDP ratio where the percentage points deviations are depicted. The blue line corresponds to the median impulse response from 1000 simulations each using different parameter values randomly selected from a uniform distribution over the parameter ranges specified in Table 1, whereas the shaded areas depict the central 68 and 90 percent of of the impulse responses.

While the response of consumption, the real exchange rate, and, to a lesser extent, CPI is qualitatively similar across all the different combinations of parameter values considered, the sign of the CA/GDP response depends on the structural parameters of the economy. Indeed, while the median response is negative, the bands are wide and cover both positive and negative values. This supports the idea that the response of the current account to a monetary policy change will depend on the structure of the economy considered, and potentially on the degree of economic regulation.

The CA/GDP response to a monetary expansion depends on which of the channels of monetary policy transmission dominates. If the import absorption channel dominates, then a monetary expansion worsens the current account. However, if the other channels - and in particular the expenditure switching channel - are strong, then a monetary expansion improves the current account position. Figure 2 shows that which of those channels dominate depends on the structure of the economy considered, and therefore potentially on the degree of regulation. We now explore whether economic regulation of financial markets affects the power of either of the transmission channels and therefore the overall impact of monetary policy on the current account.

2.3. The effect of financial liberalisation

By varying the structural parameter determining the degree of financial regulation in our DSGE model we can study the implications of financial liberalisation for the monetary policy transmission mechanism. We do so by comparing the dynamics of different variables following a monetary policy expansion in two cases: one in which the parameter of interest is fixed to a value corresponding to a relatively weak degree of regulation and one in which it is fixed to a value corresponding to a stronger degree of regulation.

To study the implications of financial regulation we vary the proportion of non-Ricardian households i.e. the proportion of households without access to both the domestic and international financial markets. This approach to modelling financial regulation relies on findings from previous empirical work. In particular, Bayoumi and Koujianou (1989) provide evidence that financial liberalisation decreased liquidity constraints across a range of industrialised countries[14], and Jappelli et al (1998) show, using US data, that the more likely is a household to be liquidity constrained, the more sensitive is its consumption to income. This relation between liquidity constraints and excess sensitivity of consumption is confirmed by Benito and Mumtaz (2006) who use microdata on UK households for 1992-2002 and find that the probability of excess sensitivity of consumption is higher for those households without asset income and for those with fewer liquid assets relative to their income. Taken together, this literature thus suggests that financial liberalisation reduces the excess sensitivity of consumption to income exhibited by non-Ricardian households.[15] We therefore proxy financial liberalisation by a fall in the proportion of non-Ricardian households i.e. households who do not have access to domestic and international financial markets. In our theoretical model this proportion is denoted λ_H^R. So, to analyse the implications of financial liberalisation on the monetary policy transmission mechanism we vary λ_H^R.

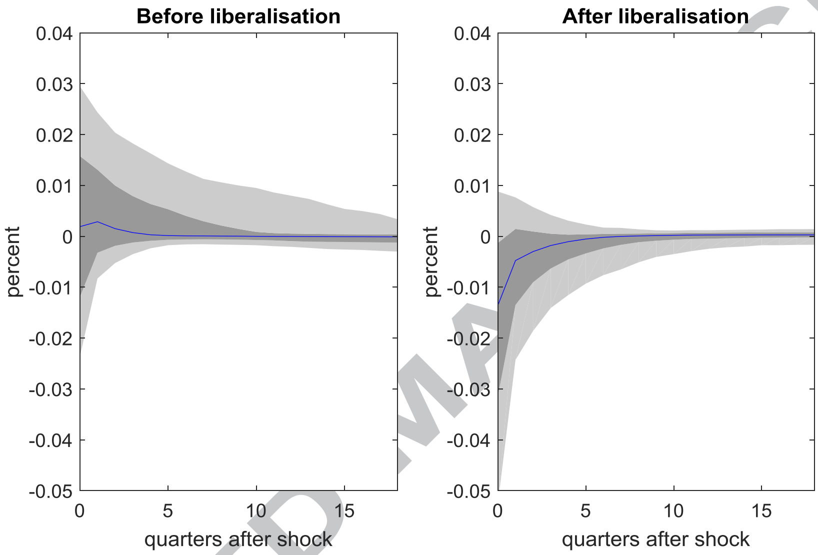
The plots in Figure 3a show the current account to GDP response to a monetary policy expansion corresponding to a 1 pp fall in the nominal interest rate in two economies: a financially repressed economy, and a financially liberalised economy. In the financially repressed economy, the proportion of non-Ricardian households is 40% ($\lambda_H^R = 0.4$). This number is in line with estimates by Campbell and Mankiw (1989) using US data over the period 1953-1986, before the process of financial liberalisation was complete. The number is also consistent with findings by Benito and Mumtaz (2006) for the UK: the upper end of their estimates of the proportion of UK households who exhibited excessive sensitivity over the period 1992-2002 is 40%. The financially liberalised economy is characterised by only 10% of households behaving in a non-Ricardian way ($\lambda_H^R = 0.1$). This is a little lower than the lower range of the estimates of the proportion of UK households who exhibited excessive sensitivity over the period 1992-2002 found by Benito and Mumtaz (2006), reflecting the possibility that financial liberalisation might have proceeded further since then. A comparison of the first and second plots shows that the current account response to the monetary expansion is clearly affected by the degree of financial liberalisation proxied by a fall in the proportion of

[14] Also, Bayoumi (1993a,b) and Sarno and Taylor (1998) provide evidence that financial liberalisation in the UK in the 1980s decreased liquidity constraints.

[15] Bandiera et al (2000) also associate financial liberalisation with a fall in the proportion of liquidity constrained households, and relate that proportion to the fraction of households deviating from optimal Ricardian consumption behaviour as determined by the consumption Euler equation. Similarly, Gali et al (2007) mention that evidence of non-Ricardian consumption behaviour might reflect the presence of liquidity-constrained households with zero net worth.

Ricardian households. While economies before financial liberalisation are more likely to experience a current account improvement following a monetary policy expansion, economies after financial liberalisation are more likely to see their current accounts deteriorate following a monetary policy expansion.

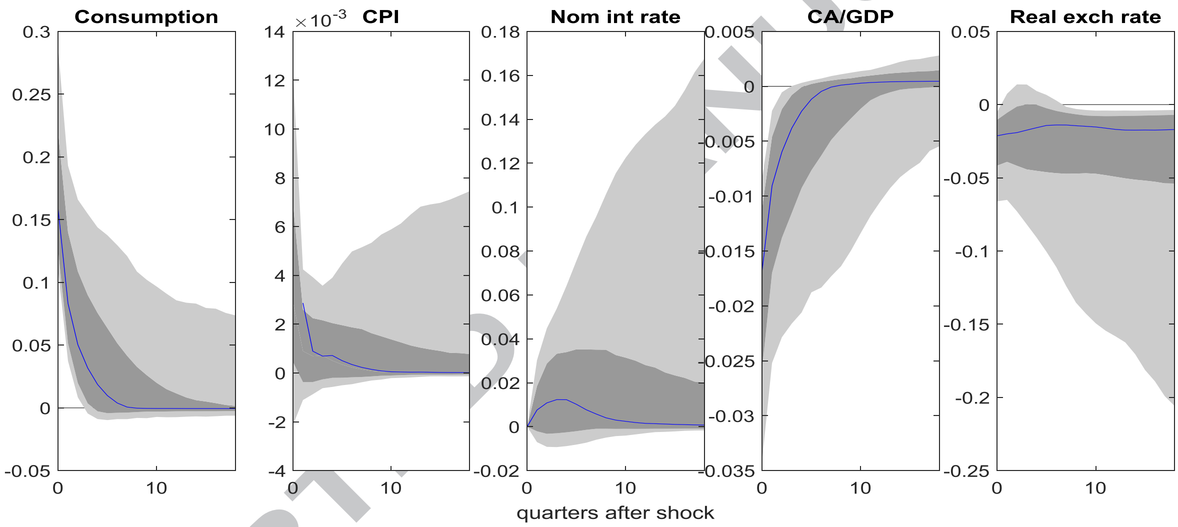
Figure 3a: CA/GDP response to a monetary expansion before and after financial market liberalisation - DSGE model



Note: The plots in Figure 3a show the distribution of the CA/GDP responses to an unexpected monetary policy expansion corresponding to a 100 basis point fall in the nominal interest rate in a financially repressed economy (before financial liberalisation) and in a financially liberalised economy (after financial liberalisation) respectively. The blue line corresponds to the median impulse response from 1000 simulations each using different parameter values randomly selected from a uniform distribution over the parameter ranges specified in Table 1 (except for the parameter proxying for the degree of regulation), whereas the shaded areas depict the central 68 and 90 percent of the impulse responses.

Figure 3b shows the *difference* between the responses of selected variables to a monetary expansion corresponding to a one percentage point fall in the nominal interest rate in an economy where the degree of financial regulation is reduced from high to low, keeping all other structural parameters constant. The fourth plot shows that financial liberalisation unambiguously makes the current account response to a monetary policy expansion more negative/less positive in the first quarters following the shock. That is, for a given economic structure, financial liberalisation always implies that a deterioration of the current account following a monetary expansion is more likely. After financial liberalisation, a higher proportion of households can bring forward consumption in the face of a fall in interest rates, meaning that the rise in aggregate domestic consumption following a monetary policy expansion is greater. This is shown in the first plot. By strengthening the response of consumption to a given monetary policy expansion, financial liberalisation also leads to a larger increase in imports. Therefore, financial liberalisation amplifies the import absorption channel and thus puts downward pressure on the current account. This effect of financial liberalisation on the current account response is consistent across all of the parameter value combinations considered, as illustrated by the shaded areas. It also holds when capital is included as a factor of production as shown in Appendix B.

Figure 3b: The effect of financial liberalisation on the monetary policy transmission - DSGE model



Note: Figure 3b shows the effect of financial market liberaliation on the transmission of an unexpected monetary policy expansion corresponding to a 100 basis point fall in the nominal interest rate. The subplots show the difference in the impulse responses following the monetary expansion of real consumption, the CPI inflation rate, the nominal interest rate, the current account to GDP ratio and the real exchange rate, between the case where the proportion of Home rule of thumb households is 10%, with all the other parameter values randomly selected from a uniform distribution over the parameter ranges specified in Table 2, and the case where the proportion of Home rule of thumb households is 40%. The blue line corresponds to the median impulse response from 1000 simulations each using different parameter values randomly selected from a uniform distribution over the parameter ranges specified in Table 2, whereas the shaded areas depict the central 68 and 90 percent of the impulse responses. All differences between impulse responses depicted are in percentage points.

3. Empirical Results

3.1. Methodology and Data

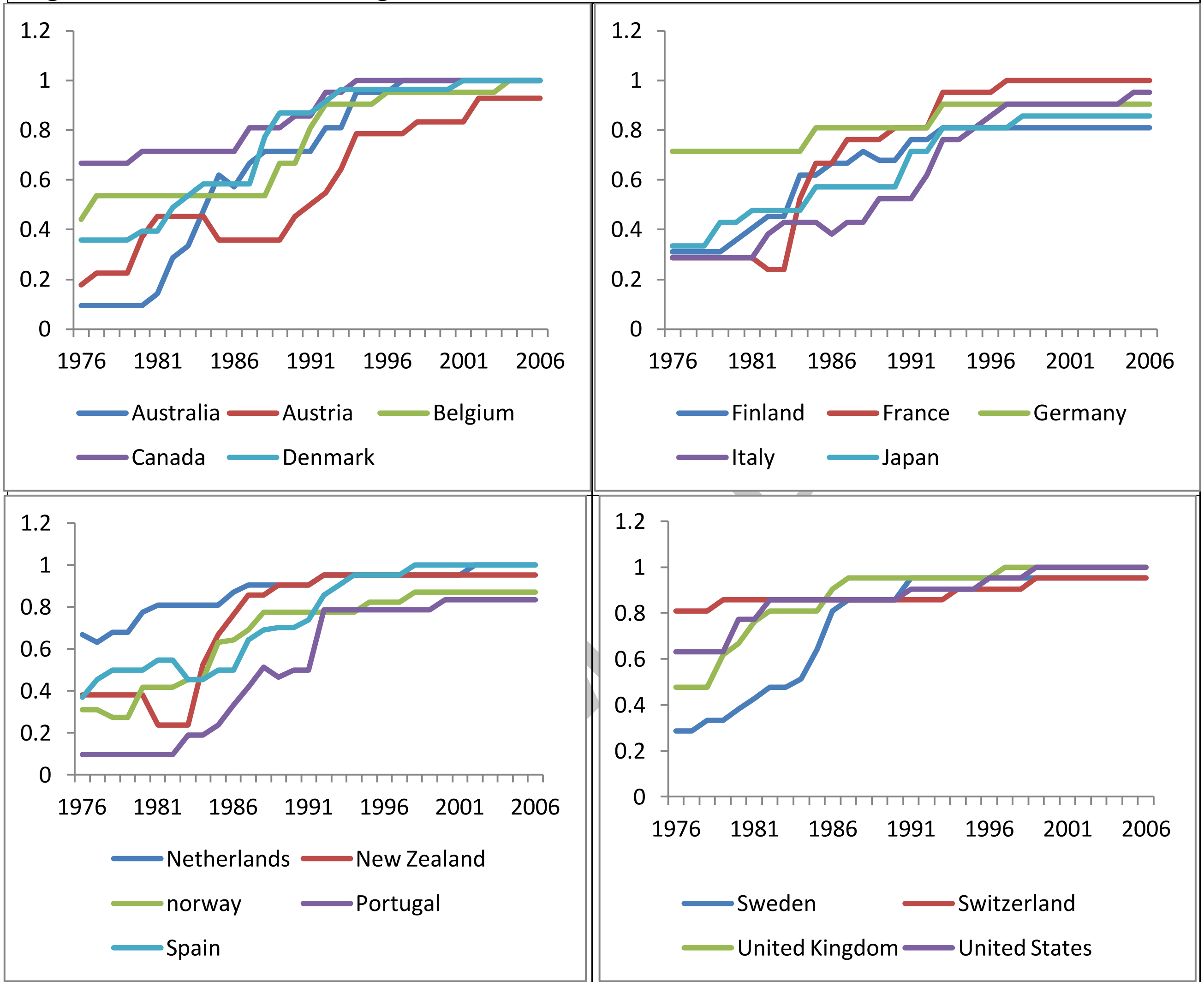
In this section we describe the data we use, the varying coefficient Bayesian panel VAR model and our identification approach.

3.1.1. Data

We use data for 19 OECD countries over the period 1976-2006 to explore whether the VAR coefficients in our empirical model vary with an index relating to the degree of financial market deregulation. To reduce possible omitted variable bias, we also allow the coefficients to vary with indices related to labour and product market deregulation. Given our interest in monetary policy shocks, we end our sample in 2006 so as to ensure that the presence of the zero lower bound and the introduction of unconventional monetary policies, which would not be captured by our VAR, do not affect our results.

Figure 4 shows the financial regulation index. It is taken from Abiad et al (2010) and has seven different components: credit controls, interest rate controls, entry barriers, state ownership in the banking sector, prudential regulation, securities market policy and capital account restrictions. Each component can take the values {0,1,2,3} with higher values meaning fewer restrictions. We sum all components to come up with the aggregate financial regulation index we use in our empirical exercise. This index is normalised to range between 0 and 1. Figure 4 shows the values of that index for the 19 OECD countries. They vary both across countries and over time.

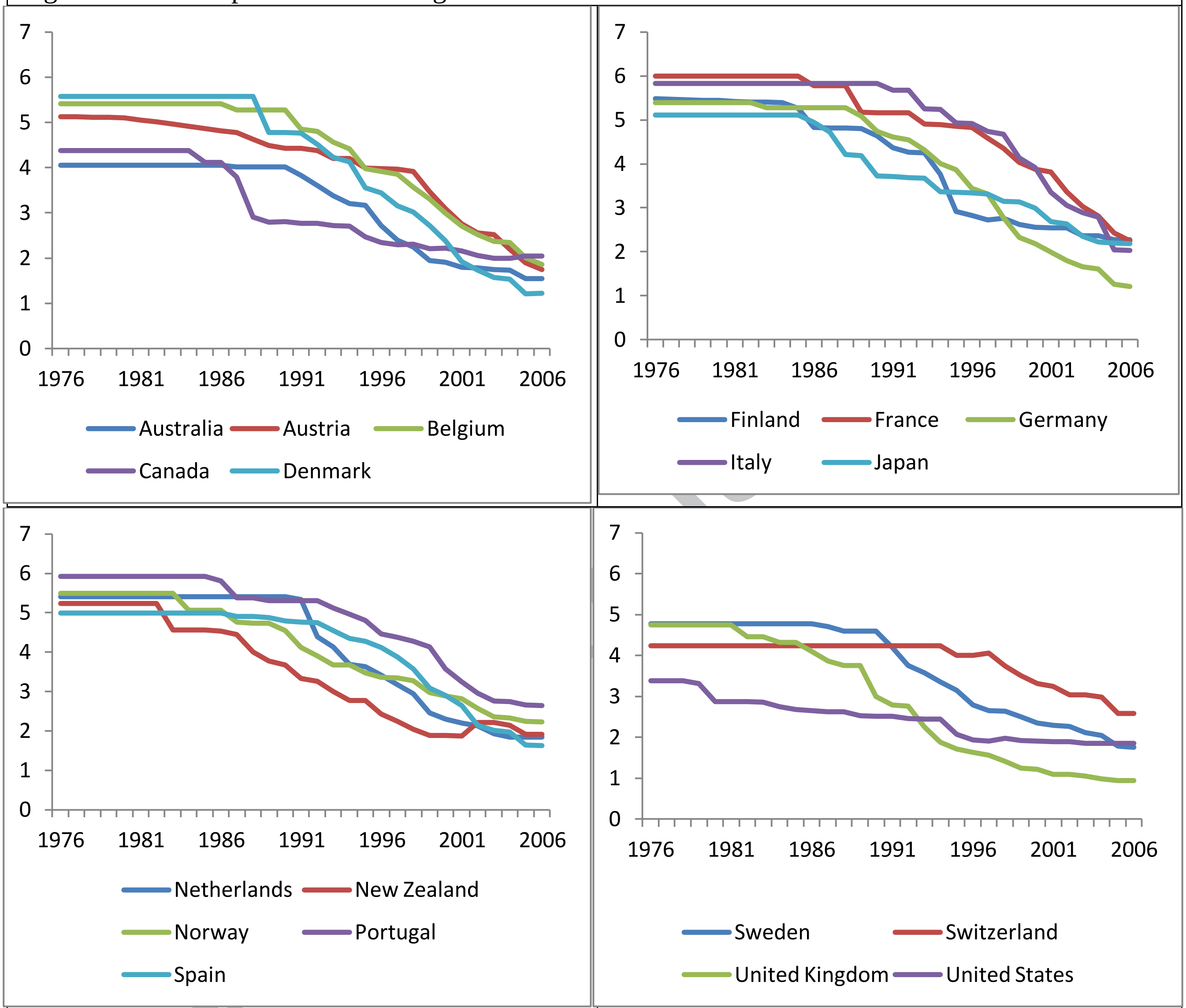
Figure 4: Index of financial regulation in 19 OECD countries



Sources & Notes: Abiad et al (2010). A low value indicates tight regulation.

To control for product market regulation we use the ETCR index constructed by Conway et al (2006), which is shown in Figure 5. It captures the level of regulation in seven non-manufacturing sectors: airlines, telecommunication, electricity, gas, post, rail and road freight. These sectors represent a substantial proportion of economic activity and constitute the area in which domestic economic regulation is most concentrated and has the greatest impact due to limited import competition. The index takes into account characteristics such as the presence of barriers to entry, public ownership, vertical integration, monopolies and the presence of legally imposed price controls, which can distort competition.

Figure 5: Index of product market regulation in 19 OECD countries

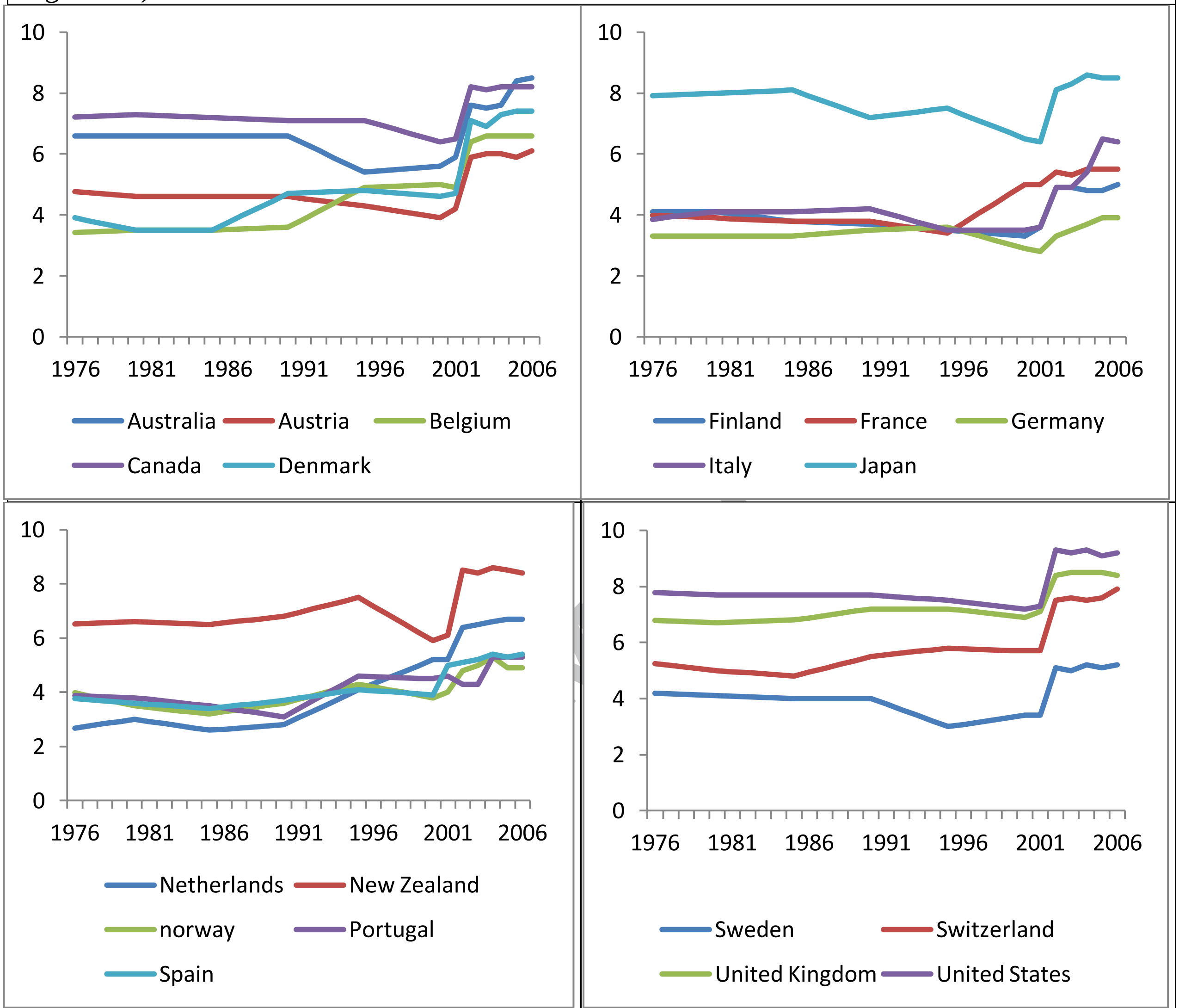


Sources & Notes: Conway et al (2006). Lower values indicate less regulation.

Figure 6 shows the index of labour market regulation that we use. This is provided by the Fraser Institute and broadly reflects minimum wage regulation, hiring and firing practices, the share of the labour force whose wages are set by centralized collective bargaining, unemployment benefits and use of conscription to obtain military personnel.[16]

[16] For more details, see Fraser Institute (2013). For Australia, the data for the labour market only begin in 1990. We interpolated the data back in time to 1975 for this country. Intuitively, this should not make a big difference since the data for most other countries only change very slowly during this time period. For robustness, we checked that this does not make a significant difference to our results.

Figure 6: Index of labour market regulation in 19 OECD countries (low value indicates tight regulation)



Sources & Notes: Fraser Institute. Higher values mean less regulation. Up until 2000, these are only available every 5 years, and the chart shows linearly interpolated values.

Finally, our VAR model consists of six endogenous variables: quarterly growth in real imported commodity prices, quarterly real consumption growth, CPI inflation, the short-term interest rate, the current account to GDP ratio and the change in the real effective exchange rate. In line with our theoretical DSGE model, the VAR model thus includes business cycle variables while allowing for exogenous trend variables (the regulation indices). All variables are in logs, except for the interest rate and the current account to GDP ratio. CPI and real exchange rate data are from the OECD Main Economic Indicators and the BIS effective exchange rate database, respectively. The remaining variables are from the OECD Economic Outlook database. It is to account for fluctuations in, and monetary policy responses to, commodity prices, that we include quarterly growth in real imported commodity prices.[17]

In our analysis of the impact of liberalisation on the transmission of monetary policy, we also control for exchange rate regime. To do so, we use the index of exchange rate flexibility developed by Ilzetzki, Reinhart and Rogoff (2017). The index is shown in Figure C.1 in Appendix C.

3.1.2 The VAR approach

We are interested in examining how changes in the structure of the macro-economy affect the monetary policy transmission mechanism in OECD countries. In particular, we are interested in testing our theoretical results and therefore we use a panel VAR approach in which the coefficients may vary with the financial regulation index. This empirical approach brings us as close as possible to the theoretical DSGE model.[18]

Previous work addressing this question relied on either time-series information within individual countries or cross-sectional differences across countries. Indeed, a number of authors have used VAR frameworks to look at the implications of economic liberalisation by exploiting only time-series variation.[19] An alternative approach has been to look at cross-sectional variation. If there are countries with similar characteristics, pooling by characteristic may offer a means of determining the structure within those countries better.[20] Finally, if the regulatory changes in question can be quantified in the form of a country-specific and time-varying index, it may appear desirable to estimate a model in which account is taken of both types of variation. This does not require the

[17] Sims and Zha (2006) argue that commodity prices in a VAR may serve as an important information variable which is a proxy for the information set of the central bank at the time of the policy decision. In other words, to the extent that the central bank reaction function implicit in the VAR might be misspecified due to omission of other variables, the inclusion of commodity prices might, at least to some extent, address this problem. For robustness, we checked that our results are unchanged if this variable is excluded.

[18] Another approach would be to use a threshold VAR model which assumes that financial liberalization is endogenous with respect to the variables in the VAR, including monetary policy. While this could be true, financial liberalization and reform is likely to change for many other reasons than just monetary policy, including evolution in economic policy thought, and hence evolve more slowly. This approach would be more restrictive than our theoretical model approach.

[19] Using such an approach, Mertens (2008) finds that the US regulation Q amplified the impact of US monetary policy. Similarly, Olivei and Tenreyro (2007, 2010) examine the impact of wage rigidity in single country VARs for the US, Japan, UK, France and Germany, by exploiting the differences in the timing of annual wage negotiations and find that monetary policy is more powerful in the presence of wage rigidities. Finally, Iacoviello and Minetti (2003) estimate single-country VARs for several countries before and after financial liberalization and find that housing prices respond to a greater extent thereafter.

[20] Assenmacher-Wesche and Gerlach (2010) estimate panel VARs for two groups of countries and find that monetary policy has a greater impact on property prices in countries with 'more' flexible financial markets. Using a similar approach, Calza et al (2013) find that property prices in countries with more developed mortgage markets show a greater reaction to an equivalently sized monetary policy shock.

sample to be split into separate groups; it needs to be done from a single pooled dataset. Some recent work has used this 'interacted panel VAR' approach (IPVAR) to explore the role of changes in economic institutions (Abritti and Weber (2010), Towbin and Weber (2013)) in the transmission of commodity price shocks. But this approach assumes that the VAR coefficients are a deterministic function of the structural characteristics in question. Unlike with stochastically varying coefficients, this assumption may result in smaller confidence bands and hence misleading inference, as demonstrated in the commodity price shock application in Wieladek (2016).

One way to allow for VAR coefficients to vary stochastically is the mean group estimator, first proposed by Pesaran and Smith (1995). Sa, Towbin and Wieladek (2014) follow this approach, but since it requires estimation country-by-country, degrees of freedom considerations typically constrain the number of structural characteristics that can be analysed and/or controlled for to a maximum of two. Wieladek (2016) proposes Bayesian shrinkage as a means of estimating panel VAR models where the coefficients are stochastic functions of several exogenous variables. Since this approach allows for both stochastic variation and multiple structural characteristics, this is the econometric approach that we choose to follow. It delivers a random effects estimator; the structure resulting from Bayesian shrinkage permits random variation both across countries and over time.

The advantage of this econometric approach is that we can formally test the implications of our theoretical model by comparing the distributions of impulse responses in the absence and presence of one particular structural characteristic. That makes it easy to understand whether and how, for instance, financial liberalisation has affected monetary policy transmission to the current account over time. Monetary policy shocks are identified with sign restrictions (see Canova and De Nicolo (2002); Uhlig (2005); Faust and Rogers (2003)), derived from our DSGE model. To ensure robustness to the type of identification, we also examine monetary policy shocks identified with lower-triangular zero restrictions, with consumption and CPI ordered before the short-term interest rate (as in Christiano, Eichenbaum and Evans, 1999).

Clearly, the VAR approach is not the only way to examine non-linearity in the transmission of economic shocks. Indeed, several papers use the local projections methods first introduced in Jorda (2005) for this purpose. Recent applications of this method range from monetary policy (Tenreyro and Thwaites, 2016), fiscal policy (Born, Pfeiffer and Mueller, 2015) to credit booms and busts (Jorda, Schularick and Taylor, 2014). But to apply this approach, it is necessary to observe the shock of interest. This is e.g. possible for US monetary policy, where Romer and Romer (2004) provide a suitable narrative series of monetary policy shocks, which is the main variable of interest to Tenreyro and Thwaites (2016). But monetary policy shocks cannot be observed directly in most countries. Indeed, the most important reasons why we use the VAR framework, as opposed to the local projections approach, is that the former helps us to identify monetary policy shocks directly.

3.1.3. The Varying Coefficient Bayesian panel VAR model

We follow the approach outlined in Wieladek (2016) and model the individual VAR coefficients as functions of financial, labour and product market regulation in a given country within a panel data structure. We also control for the exchange rate regime; see Appendix C for more details. In particular, we estimate the following panel VAR model:[21]

$$\boldsymbol{Y_{c,t}} = \boldsymbol{k_{c,\tau}} + \boldsymbol{X_{c,t}B_{c,\tau}} + \boldsymbol{e_{c,t}} \qquad \boldsymbol{e_{c,t}} \sim \boldsymbol{N}(\boldsymbol{0}, \boldsymbol{A_{c,\tau}^{'}\Sigma_c A_{c,\tau}}) \qquad (1)$$

$$\boldsymbol{k_{c,\tau}} = \boldsymbol{k_0} + \boldsymbol{D_{c,\tau}\delta_k} + \boldsymbol{u_{kc,\tau}} \qquad \boldsymbol{u_{kc,\tau}} \sim \boldsymbol{N}(\boldsymbol{0}, \boldsymbol{\Lambda_{kc}}) \qquad (2)$$

$$\boldsymbol{B_{c,\tau}} = \boldsymbol{B_0} + \boldsymbol{D_{c,\tau}\delta_B} + \boldsymbol{u_{Bc,\tau}} \qquad \boldsymbol{u_{Bc,\tau}} \sim \boldsymbol{N}(\boldsymbol{0}, \boldsymbol{\Lambda_{Bc}}) \qquad (3)$$

$$\boldsymbol{A_{c,\tau}} = \boldsymbol{A_0} + \boldsymbol{D_{c,\tau}\delta_A} + \boldsymbol{u_{Ac,\tau}} \qquad \boldsymbol{u_{Ac,\tau}} \sim \boldsymbol{N}(\boldsymbol{0}, \boldsymbol{\Lambda_{Ac}}) \qquad (4)$$

where $\boldsymbol{Y_{c,t}}$ is a matrix with $\boldsymbol{N}$ endogenous variables in the columns at time $\boldsymbol{t}$, in country $\boldsymbol{c}$, with the total number of countries $\boldsymbol{C}$. $\boldsymbol{Y_{c,t}}$ consists of the quarterly growth in real imported commodity prices, the quarterly growth rate of real consumption, quarterly CPI inflation, the short-term interest rate, the current account to GDP ratio and the log change in the real exchange rate. $\boldsymbol{X_{c,t}}$ contains the lags of the variables in $\boldsymbol{Y_{c,t}}$ for

[21] The description of most of the components of our proposed model closely follows the presentation of Jarocinski (2010) and Wieladek (2016). See their work for more details.

country $\boldsymbol{c}$ at time $\boldsymbol{t}$. $\boldsymbol{B}_{\boldsymbol{c},\boldsymbol{\tau}}$ is the array of associated coefficients for country $\boldsymbol{c}$ at time $\boldsymbol{\tau}$. $\boldsymbol{k}_{\boldsymbol{c},\boldsymbol{\tau}}$ is a constant term. We assume that the corresponding vector of VAR residuals $\boldsymbol{e}_{\boldsymbol{c},\boldsymbol{t}}$ is distributed with a zero mean and a co-variance matrix that is the product of the lower triangular matrix $\boldsymbol{A}_{\boldsymbol{c},\boldsymbol{\tau}}$ and a diagonal matrix of structural shocks $\boldsymbol{\Sigma}_{\boldsymbol{c}}$, which is assumed to be normally distributed. $\boldsymbol{B}_{\boldsymbol{c},\boldsymbol{\tau}}$ and $\boldsymbol{A}_{\boldsymbol{c},\boldsymbol{\tau}}$ are modelled as linear functions of pre-determined variables $\boldsymbol{D}_{\boldsymbol{c},\boldsymbol{\tau}}$ with the associated coefficients $\boldsymbol{\delta}_{\boldsymbol{B}}$ and $\boldsymbol{\delta}_{\boldsymbol{A}}$, respectively. Note that the coefficients vary with $\boldsymbol{\tau}$, as oppose to, $\boldsymbol{t}$. This mixed frequency structure is an advantage of our framework, since indices of economic regulation in $\boldsymbol{D}_{\boldsymbol{c},\boldsymbol{\tau}}$ are available only at an annual, as opposed to quarterly frequency. And the labour market index is available only every 5 years up until 2000. We therefore set $\boldsymbol{D}_{\boldsymbol{c},\boldsymbol{\tau}} = \frac{\sum_{l=1}^{Z} \boldsymbol{D}_{\boldsymbol{c},\boldsymbol{t}-\boldsymbol{l}}}{\boldsymbol{\Xi}}$, where $\boldsymbol{\Xi} = \mathbf{20}$, meaning all of the other indices are 5-year moving averages of the corresponding annual figures. In other words, since the sample period starts in 1976, then $\boldsymbol{D}_{\boldsymbol{c},\mathbf{1}}$ is the average for 1976-1980, $\boldsymbol{D}_{\boldsymbol{c},\mathbf{2}}$ the average for 1981-1985 and so forth. $\boldsymbol{B}_{\boldsymbol{c},\mathbf{1}}, \boldsymbol{B}_{\boldsymbol{c},\mathbf{2}}$ and $\boldsymbol{A}_{\boldsymbol{c},\mathbf{1}}, \boldsymbol{A}_{\boldsymbol{c},\mathbf{2}}$ would then be the corresponding arrays of coefficients for that period. A second advantage of this approach is that 5-year averages of these indicators are less likely to be endogenous with respect to the business cycle and monetary policy specifically, and hence more likely to satisfy the model assumption that these variables are predetermined. And also, in contrast to using annual indices, using 5-year averages reduces the computing time needed, facilitating the robustness checks described in the appendices to this paper.[22]

In sum, $\boldsymbol{D}_{\boldsymbol{c},\boldsymbol{\tau}}$ contains the exchange rate, financial, labour and product market regulation indices. In the description of the Gibbs sampler in Appendix C, we include the vector of constant terms, $\boldsymbol{k}_{\boldsymbol{c},\boldsymbol{\tau}}$, in $\boldsymbol{B}_{\boldsymbol{c},\boldsymbol{\tau}}$ and redefine $\boldsymbol{\delta}_{\boldsymbol{B}}$ and $\boldsymbol{\delta}_{\boldsymbol{A}}$ to include $\boldsymbol{B}_{\mathbf{0}}$ and $\boldsymbol{A}_{\mathbf{0}}$, respectively. In this case, equations (1) – (4) simplify to $\boldsymbol{Y}_{\boldsymbol{c},\boldsymbol{t}} = \boldsymbol{X}_{\boldsymbol{c},\boldsymbol{t}}\boldsymbol{B}_{\boldsymbol{c},\boldsymbol{\tau}} + \boldsymbol{e}_{\boldsymbol{c},\boldsymbol{t}}$, $\boldsymbol{B}_{\boldsymbol{c},\boldsymbol{\tau}} = \boldsymbol{D}_{\boldsymbol{c},\boldsymbol{\tau}}\boldsymbol{\delta}_{\boldsymbol{B}} + \boldsymbol{u}_{\boldsymbol{B}\boldsymbol{c},\boldsymbol{\tau}}$ and $\boldsymbol{A}_{\boldsymbol{c},\boldsymbol{\tau}} = \boldsymbol{D}_{\boldsymbol{c},\boldsymbol{\tau}}\boldsymbol{\delta}_{\boldsymbol{A}} + \boldsymbol{u}_{\boldsymbol{A}\boldsymbol{c},\boldsymbol{\tau}}$, respectively.

[22] We also estimated the model with one-year averages for the indices and found similar results. We focus, however, on five-year averages because the risk of endogeneity is much reduced.

3.1.4. Identification

We adopt the sign restrictions identification approach, pioneered by Canova and De Nicolo (2002) and Uhlig (2005), to search over all possible decompositions of $\boldsymbol{A}_{\boldsymbol{c},\boldsymbol{\tau}}$, which produce orthogonal error terms, and retain those which generate impulse responses that are consistent with the expected signs for that particular shock. Fry and Pagan (2011) argue that the median impulse response recovered with sign restrictions may be different from the true data generating process, though Canova and Paustian (2011) show that this is not the case as long as all reasonable restrictions are imposed. This is exactly why we identify all plausible shocks, though we are interested only in impulse responses to monetary policy shocks.

The sign restrictions we impose for identification are shown in Table 2. These are based on the theoretical predictions from our DSGE model and are thus consistent with the impulse responses shown in Figure 2. We assume that an expansionary monetary policy shock leads to fall in the short-term rate and an increase in the level of consumption and prices. A positive aggregate demand shock leads to a rise in prices, consumption and the short-term rate, as the central bank reacts to this to contain inflation expectations. Finally, a positive aggregate supply shock is assumed to lead to a fall in prices and a rise in consumption. As most of the countries in our study can be considered small open economies, we also add a restriction on the real exchange rate, namely that it depreciates (appreciates) in response to an expansionary monetary policy (aggregate demand) shock. These restrictions are imposed contemporaneously and for one period thereafter.

Table 2. Sign restrictions

	y Consumption	p Consumer prices	i_t interest rates	ca_t Current Account	q Real exchange rate
Supply Shock	+	−			
Demand Shock	+	+	+		+
Monetary Policy Shock	+	+	−		−

Clearly, the sign restrictions approach is not the only way to identify monetary policy shocks. To ensure that our results are robust to identification, we therefore also identify the monetary policy shock via a lower triangular decomposition of $\boldsymbol{A_{c,\tau}}$, with the growth rate of real imported commodity prices ordered first and the remainder of the ordering as presented in the first row of Table 2. Given that the interest rate is ordered after consumption and prices, our identification scheme encompasses the standard assumption that real activity reacts to monetary policy only with a lag. The second implicit assumption in this identification scheme is that the monetary policy authority reacts only with a lag to the real exchange rate and the current account balance.

3.1.5 Assessing the Impact of Changes in Economic Structure

From equations (2) and (3), it is easy to see that cross-sectional and time-variation in the main coefficients of our model, $\boldsymbol{B_{c,\tau}}$ and $\boldsymbol{A_{c,\tau}}$, is a function of

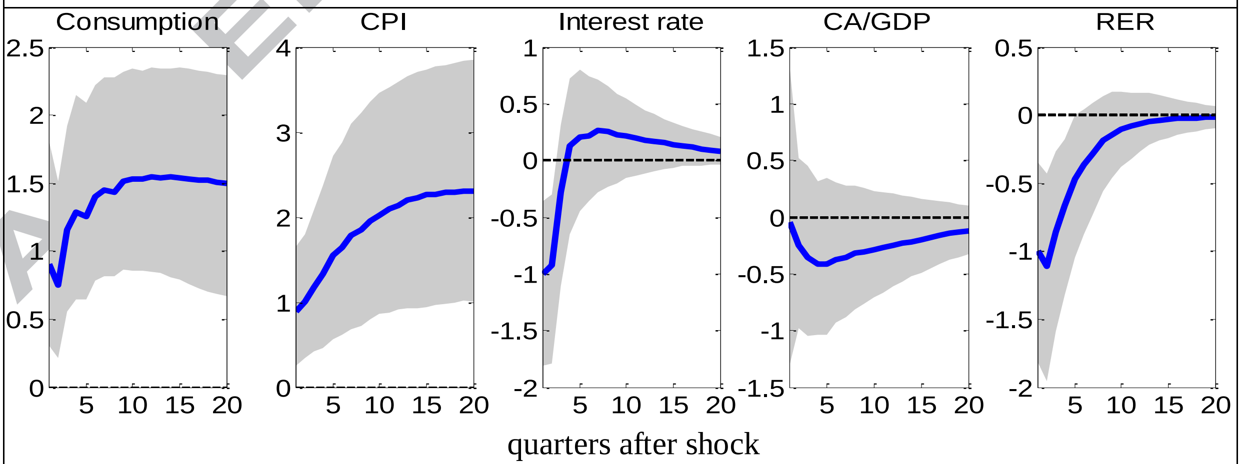
$$\boldsymbol{D_{c,t}} = \left[\boldsymbol{1}\ \boldsymbol{EFX_{c,t}}\quad \boldsymbol{FIN_{c,t}}\quad \boldsymbol{LABOUR_{c,t}}\quad \boldsymbol{PROD_{c,t}}\right],$$

where $\boldsymbol{EFX_{c,t}}$, $\boldsymbol{FIN_{c,t}}$, $\boldsymbol{LABOUR_{c,t}}$ and $\boldsymbol{PROD_{c,t}}$ are indices of exchange rate regime flexibility, financial, labour market and product market regulation, respectively. Prior to structural analysis, the individual elements of $\boldsymbol{D_{c,\tau}}$ need to be fixed at certain values. For example, to obtain median VAR coefficients across time and country, it is necessary to evaluate all of the elements of $\boldsymbol{D_{c,\tau}}$ at their median values. From (3) and (4), this would yield draws of $\boldsymbol{B_{c,\tau}^{MED}}$ and $\boldsymbol{A_{c,\tau}^{MED}}$, which can then be used for identification. Similarly, it is possible to examine how these coefficients, and the implied impulse responses, are affected by financial market regulation in the following manner. First, evaluate financial regulation at a high value (defined as the 90th percentile of values realised in the sample) with all the other characteristics evaluated at their medians to obtain draws of $\boldsymbol{B}_{c,\tau}^{FINHIGH}$ and $\boldsymbol{A}_{c,\tau}^{FINHIGH}$ and the associated distribution of impulse responses. Repeat the previous step, but this time with a low value of financial regulation (defined as the 10th percentile) to obtain draws of $\boldsymbol{B}_{c,\tau}^{FINLOW}$ and $\boldsymbol{A}_{c,\tau}^{FINLOW}$. A comparison of these two distributions, subject to the same size shock, allows us to infer the effect of financial liberalisation on the monetary policy transmission mechanism.

3.2. The transmission of monetary policy to the current account – evidence

In line with the DSGE model, the VAR shows that a one percentage point fall in the nominal interest rate leads to an increase in consumption and in CPI as well as to a fall in the real exchange rate. This is illustrated in Figure 7 below which shows the impulse response functions of selected variables to a one percentage point fall in the nominal interest rate. Also, we again find that the response of consumption, CPI and the real exchange rate is significant while the response of the CA/GDP is negative but insignificant and the bands are wide and cover both positive and negative values. Our VAR model thus supports the theoretical model which showed that the response of the current account to a monetary policy change will depend on the structure of the economy considered, and possibly on the degree of economic regulation.

Figure 7. Impact of a monetary policy expansion - VAR model



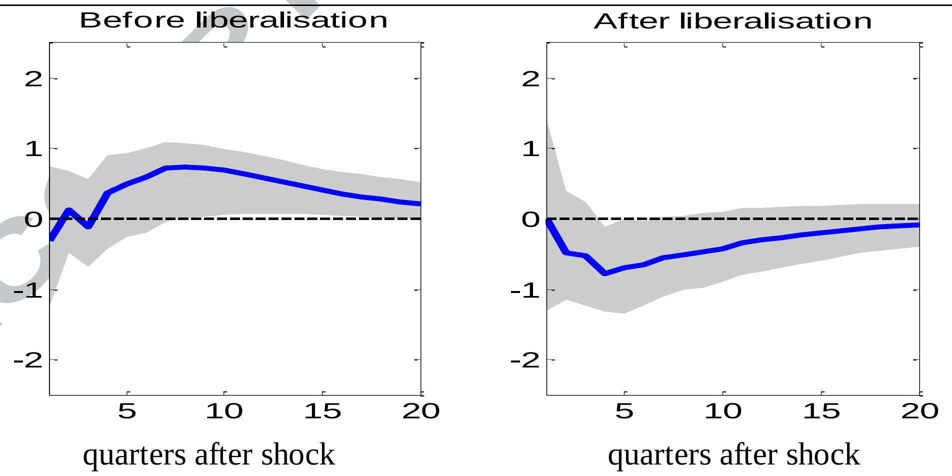
Note: Figure 7 shows the transmission of an unexpected monetary expansion, identified with sign restrictions. It shows impulse responses, in percent, to a 100 basis point monetary expansion of real consumption, the CPI, the short interest rate, the current account to GDP ratio and the log of the real exchange rate. For the CPI, real consumption and the real exchange rate, cumulated impulse responses are shown, as these variables enter the model in log differences. It shows the responses when all of the exchange rate, financial, labour and product market indices have been evaluated at the sample medians. The median is the blue line and 68% quantiles, which are calculated from 500 draws that satisfy the sign restrictions, are reported in the grey area.

We now consider whether liberalisation of the financial markets affects the impact of monetary policy on the current account, as predicted by the DSGE model.

3.3 The effect of financial liberalisation on the transmission of monetary policy - evidence

The first plot in Figure 8a shows the estimated CA/GDP response to a monetary policy expansion corresponding to a 1 percentage point fall in the interest rate, when the financial regulation index has been evaluated at the 10th percentile of values realised in the sample, with all the other indices evaluated at their medians. The second plot shows the CA/GDP response to the same monetary policy shock, but when the financial regulation index has been evaluated at the 90th percentile of sample values. The figure clearly shows that, following a monetary policy expansion, the current account improves in countries and time periods where the degree of financial regulation is high, but is likely to deteriorate in countries and time periods in which financial regulation is low. The change in the current account is statistically significant and peaks after 1-2 years.

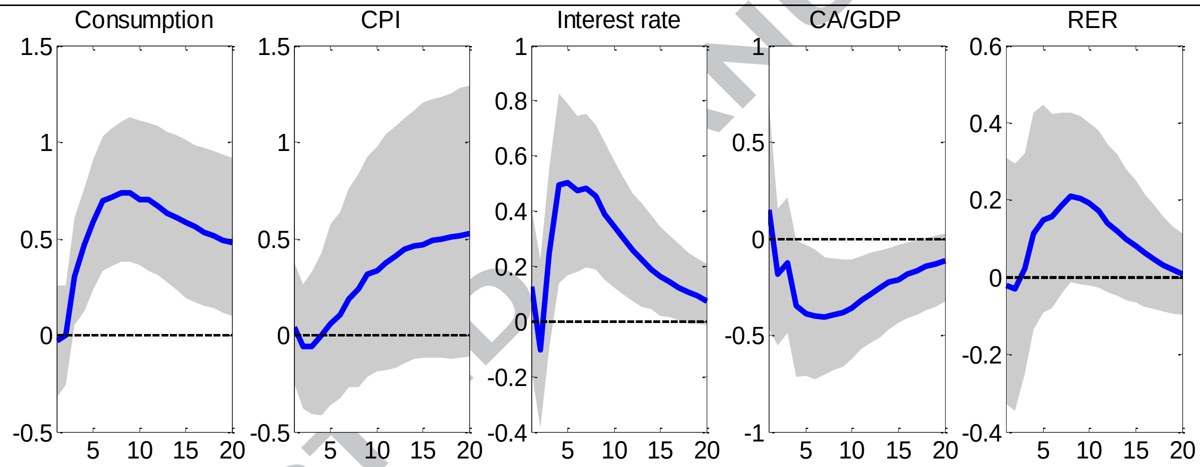
Figure 8a. CA/GDP following a monetary policy expansion before and after financial markets liberalisation - VAR model



Note: Figure 8a shows the effect of financial liberaliation on the transmission of an unexpected monetary policy expansion to CA/GDP, identified with sign restrictions. It shows the impulse response when all of the exchange rate, labour and product market indices have been evaluated at the sample medians, while the financial regulation measure is evaluated at the 10th and 90th percentiles respectively. The median is the blue line and 68% quantiles, which are calculated from 500 draws that satisfy the sign restrictions, are reported in the grey area.

Moreover, the difference between the two cases is statistically significant, as shown in Figure 8b which reports the median and 68% quantiles based on the *difference* in impulse responses between the low and high financial regulation cases described above. As predicted by the theoretical model, the reaction of consumption is stronger in a financially liberalised economy and this is statistically significant. The difference in current account reaction is negative and statistically significant, which suggests that the import-absorption channel dominates in a more financially liberalised economy.

Figure 8b: The effect of financial liberalisation on the monetary policy transmission mechanism – Identified with sign restrictions



Note: Figure 8b shows the effect of financial liberaliation on the transmission of an unexpected monetary policy expansion, identified with sign restrictions. It show the difference in impulse responses to a 100 basis point monetary policy expansion of real consumption, the CPI, the short interest rate, the current account to GDP ratio and the log of the real exchange rate between the case where financial regulation is low and the case where it is high. For the CPI, real consumption and the real exchange rate, cumulated impulse responses are shown, as these variables enter the model in log differences. The median is the blue line and 68% quantiles, which are calculated from 500 draws that satisfy the sign restrictions, are reported in the grey area.

Overall, these impulses responses are in line with the predictions of our open-economy DSGE model, though the current account response is more sluggish in the empirical than in the theoretical model.[23] Our empirical results confirm that the current account is more likely to deteriorate in response to a monetary policy expansion in a more financially liberalised economy, and that this appears to be driven by the consumption response.

[23] This is not surprising given that the theoretical model does, for simplicity, not include features such as habits in consumption which would result in a more sluggish adjustment.

In appendices D and E we carry out a series of robustness checks looking at an alternative identification strategy (the triangular identification scheme decribed in Section 3.1.4) and a possible role for year fixed effects. We have also checked the sensitivity of our results to the role of commodity prices, the inclusion of Australia for whom the regulation data are limited, and a measure of global financial regulation. These results are not reported here, but available upon request. These checks suggest that our empirical results are robust to minor perturbations of the baseline model.

4. Discussion and conclusion

Does the current account improve or deteriorate following a monetary policy expansion? Our two-country DSGE model shows that the answer to this question depends on the degree of financial market regulation. To test these predictions, we estimate a varying coefficient Bayesian panel VAR model on quarterly data from 19 OECD countries over the period 1976 to 2006. The model's coefficients are allowed to vary stochastically over time as a function of the exchange rate regime, and of financial, labour and product market regulation. This allows us to compare current account responses to the same monetary policy shock under different types of regulation and hence establish whether financial liberalisation affects the transmission of monetary policy to the current account empirically.

Our theoretical model suggests that financial liberalisation amplifies the impact of monetary policy on consumption thus strengthening the income-absorption channel of monetary policy. Consistent with that, our empirical results show a persistent deterioration in the current account following an unexpected monetary expansion in less financially regulated economies.

Overall, our findings suggest that the effect of monetary policy on the current account depends on the structure of the economy in question. This might explain why studies considering different time periods or countries haven't found a clear answer to whether monetary policy leads to a current account improvement or to a deterioration. It has important implications for macroeconomic policy if policy makers are tempted to use monetary policy to rectify large and persistent current account imbalances to the extent that these are considered to be undesirable (King, 2009). Our research implies that policy makers need to think carefully about the degree of regulation in financial markets to anticipate how monetary policy will affect the current account. This is particularly important for monetary policy makers in the euro area as our research indicates that it is likely that the impact of a monetary policy action by the ECB could lead to different qualitative impacts on the current accounts of the different countries of the area. From a practical perspective, our research implies that any country-by-country estimation of the impact of monetary policy on the current account using only time-series data cannot be used to examine how monetary policy affects the current account unless the pattern of regulation has remained unchanged.

Appendix A. DSGE model equilibrium equations

The equilibrium is a set of stationary processes

$$\left\{\begin{array}{c} Y_t, Y_t^*, Y_{H,t} Y_{F,t}, C_t \ , C_t^*, C_{N,t}, C_{N,t}^*, C_{T,t}, C_{T,t}^*, L_{T,t}^O, L_{N,t}^O \ , L_{T,t}^{O*}, L_{N,t}^{O*} \ , C_t^R, C_t^{R*}, C_t^O, C_t^{O*}, L_{T,t}^R, L_{T,t}^{R*}, L_{N,t}^R, L_{N,t}^{R*}, \\ L_{T,t}, L_{T,t}^*, L_{N,t}, L_{N,t}^* \left(\frac{P_{H,t}}{P_{T,t}}\right), \left(\frac{P_{F,t}^*}{P_{T,t}^*}\right), \left(\frac{P_{T,t}}{P_t}\right), \left(\frac{P_{T,t}^*}{P_t^*}\right), \left(\frac{P_{N,t}}{P_t}\right), \left(\frac{P_{N,t}^*}{P_t^*}\right), \left(\frac{s_t P_{T,t}^*}{P_{T,t}}\right), Q_t, \left(\frac{B_{F,t}}{P_t}\right), \pi_{H,t}, \pi_{F,t}^*, \pi_{N,t}, \pi_{N,t}^*, \\ \left(\frac{W_{T,t}}{P_{T,t}}\right), \left(\frac{W_{T,t}^*}{P_{T,t}^*}\right), \left(\frac{W_{N,t}}{P_t}\right), \left(\frac{W_{N,t}^*}{P_t^*}\right), \pi_{H,t}^W, \pi_{F,t}^{W*}, \pi_{N,t}^W, \pi_{N,t}^{W*}, Disp_t \ , Disp_t^N, Disp_t^*, Disp_t^{N*} \\ x_{1,t}, x_{1,t}^*, x_{2,t}, x_{2,t}^*, x_{1,t}^N, x_{1,t}^{N*}, x_{2,t}^N, x_{2,t}^{N*}, x_{1,t}^W, x_{1,t}^{W*}, x_{2,t}^W, x_{2,t}^{W*}, x_{1,t}^{WN}, x_{1,t}^{WN*}, x_{2,t}^{WN}, x_{2,t}^{WN*}, i_t \ , i_t^* \end{array}\right\}$$

for $t \geq 0$ which satisfy the 69 equilibrium equations below given $\{\psi_t^I, \psi_t^{I*}\}_{t=0}^{\infty}$ and the initial conditions consisting of the variables above for $t < 0$.

Equilibrium equations:

Aggregate demand and output:

$$Y_{H,t} = a_H \left(\frac{P_{H,t}}{P_{T,t}}\right)^{-\varphi} C_{T,t} + \frac{1-n}{n}(1-a_F)\left(\frac{P_{H,t}}{P_{T,t}}\right)^{-\varphi}\left(\frac{s_t P_{T,t}^*}{P_{T,t}}\right)^{\varphi} C_{T,t}^*$$

$$Y_{F,t} = \frac{n}{1-n}(1-a_H)\left(\frac{P_{F,t}^*}{P_{T,t}^*}\right)^{-\varphi}\left(\frac{s_t P_{T,t}^*}{P_{T,t}}\right)^{-\varphi} C_{T,t} + a_F \left(\frac{P_{F,t}^*}{P_{T,t}^*}\right)^{-\varphi} C_{T,t}^*$$

$$Y_t = \left(\frac{P_{H,t}}{P_t}\right) Y_{H,t} + \left(\frac{P_{N,t}}{P_t}\right) C_{N,t}$$

$$Y_t^* = \left(\frac{P_{F,t}^*}{P_t^*}\right) Y_{F,t} + \left(\frac{P_{N,t}^*}{P_t^*}\right) C_{N,t}^*$$

Consumption demand:

$$C_{T,t} = a_T \left(\frac{P_{T,t}}{P_t}\right)^{-\varphi_H^N} C_t$$

$$C_{N,t} = (1-a_T)\left(\frac{P_{N,t}}{P_t}\right)^{-\varphi_H^N} C_t$$

$$C_{T,t}^* = a_T^* \left(\frac{P_{T,t}^*}{P_t^*}\right)^{-\varphi_H^N} C_t^*$$

$$C_{N,t}^* = (1-a_T^*)\left(\frac{P_{N,t}^*}{P_t^*}\right)^{-\varphi_H^N} C_t^*$$

Price equations:

$$\frac{x_{1,t}}{x_{2,t}} = \left(\frac{1-\alpha_H^T \pi_{H,t+1}^{\theta_H^T-1}}{1-\alpha_H^T}\right)^{\frac{1}{1-\theta_H^T}}$$

$$\frac{x_{1,t}^N}{x_{2,t}^N} = \left(\frac{1-\alpha_H^N \pi_{N,t+1}^{\theta_H^N-1}}{1-\alpha_H^N}\right)^{\frac{1}{1-\theta_H^N}}$$

$$x_{1,t} = \frac{\theta_H^T}{(\theta_H^T-1)} Y_{H,t}\, C_t^{O-\sigma_H} \frac{W_{T,t}}{P_{T,t}} \frac{P_{T,t}}{P_t} + \alpha_H^T \beta \pi_{H,t+1}^{\theta_H^T} x_{1,t+1}$$

$$x_{1,t}^N = \frac{\theta_H^N}{(\theta_H^N-1)} C_{N,t}\, C_t^{O-\sigma_H} \frac{W_{N,t}}{P_t} + \alpha_H^N \beta \pi_{N,t+1}^{\theta_H^N} x_{1,t+1}^N$$

$$x_{2,t} = (1+\tau_H^T) Y_{H,t}\, C_t^{O-\sigma_H} \frac{P_{H,t}}{P_{T,t}} \frac{P_{T,t}}{P_t} + \alpha_H^T \beta \pi_{H,t+1}^{\theta_H^T-1} x_{2,t+1}$$

$$x_{2,t}^N = (1+\tau_H^N) C_{N,t}\, C_t^{O-\sigma_H} \frac{P_{N,t}}{P_t} + \alpha_H^N \beta \pi_{N,t+1}^{\theta_H^N-1} x_{2,t+1}^N$$

$$Disp_t = (1-\alpha_H^T)\left(\frac{1-\alpha_H^T \pi_{H,t}^{\theta_H^k-1}}{1-\alpha_H^T}\right)^{\frac{-\theta_H^T}{1-\theta_H^T}} + \alpha_H^T \pi_{H,t}^{\theta_H^T} Disp_{t-1}$$

$$Disp_t^N = (1-\alpha_H^N)\left(\frac{1-\alpha_H^N \pi_{N,t}^{\theta_H^N-1}}{1-\alpha_H^N}\right)^{\frac{-\theta_H^T}{1-\theta_H^T}} + \alpha_H^N \pi_{N,t}^{\theta_H^N} Disp_{t-1}^N$$

$$\frac{x_{1,t}^*}{x_{2,t}^*} = \left(\frac{1-\alpha_F^T \pi_{F,t+1}^{*\theta_F^T-1}}{1-\alpha_F^T}\right)^{\frac{1}{1-\theta_F^T}}$$

$$\frac{x_{1,t}^{N*}}{x_{2,t}^{N*}} = \left(\frac{1-\alpha_F^N \pi_{N,t+1}^{*\theta_F^N-1}}{1-\alpha_F^N}\right)^{\frac{1}{1-\theta_F^N}}$$

$$x_{1,t}^* = \frac{\theta_F^T}{(\theta_F^T-1)} Y_{F,t}\, C_t^{O*-\sigma_H} \frac{W_{T,t}^*}{P_{T,t}^*} \frac{P_{T,t}^*}{P_t^*} + \alpha_F^T \beta \pi_{F,t+1}^{*\theta_F^T} x_{1,t+1}^*$$

$$x_{1,t}^{N*} = \frac{\theta_F^N}{(\theta_F^N-1)} C_{N,t}^*\, C_t^{O*-\sigma_H} \frac{W_{N,t}^*}{P_t^*} + \alpha_F^N \beta \pi_{N,t+1}^{*\theta_F^N} x_{1,t+1}^{N*}$$

$$x_{2,t}^{*} = (1+\tau_F^T)Y_{F,t}\, C_t^{O*-\sigma_H}\frac{P_{F,t}^*}{P_{T,t}^*}\frac{P_{T,t}^*}{P_t^*} + \alpha_F^T\beta\pi_{F,t+1}^{*\theta_F^T-1}x_{2,t+1}^*$$

$$x_{2,t}^{N*} = (1+\tau_F^N)C_{N,t}^*\, C_t^{O*-\sigma_F}\frac{P_{N,t}^*}{P_t^*} + \alpha_F^N\beta\pi_{F,t+1}^{*\theta_F^N-1}x_{2,t+1}^{N*}$$

$$Disp_t^* = (1-\alpha_H^T)\left(\frac{1-\alpha_H^T\pi_{H,t}^{\theta_H^k-1}}{1-\alpha_H^T}\right)^{\frac{-\theta_H^T}{1-\theta_H^T}} + \alpha_H^T\pi_{H,t}^{\theta_H^T}Disp_{t-1}$$

$$Disp_t^{N*} = (1-\alpha_F^N)\left(\frac{1-\alpha_F^N\pi_{N,t}^{*\theta_F^N-1}}{1-\alpha_F^N}\right)^{\frac{-\theta_F^N}{1-\theta_F^N}} + \alpha_F^N\pi_{N,t}^{\theta_F^N}Disp_{t-1}^{N*}$$

$$\pi_{N,t} = \frac{P_{N,t}}{P_t}\frac{P_{t-1}}{P_{N,t-1}}\frac{P_{H,t-1}}{P_{T,t-1}}\frac{P_{T,t}}{P_{H,t}}\frac{P_{T,t-1}}{P_{t-1}}\frac{P_t}{P_{T,t}}\pi_{H,t}$$

$$\pi_{N,t}^* = \frac{P_{N,t}^*}{P_t^*}\frac{P_{t-1}^*}{P_{N,t-1}^*}\frac{P_{F,t-1}^*}{P_{T,t-1}^*}\frac{P_{T,t}^*}{P_{F,t}^*}\frac{P_{T,t-1}^*}{P_{t-1}^*}\frac{P_t^*}{P_{T,t}^*}\pi_{F,t}^*$$

Wage equations:

$$\frac{x_{1,t}^W}{x_{2,t}^W} = \left(\frac{1-\alpha_H^W\pi_{H,t}^{W\theta_H^W-1}}{1-\alpha_H^W}\right)^{\frac{1+\theta_H^W\eta_H}{1-\theta_H^W}}$$

$$\frac{x_{1,t}^{WN}}{x_{2,t}^{WN}} = \left(\frac{1-\alpha_{HN}^W\pi_{N,t}^{W\theta_{HN}^W-1}}{1-\alpha_{HN}^W}\right)^{\frac{1+\theta_{HN}^W\eta_H}{1-\theta_{HN}^W}}$$

$$x_{1,t}^W = \frac{\theta_H^W}{(\theta_H^W-1)}\left(\frac{L_{T,t}^O}{a_T}\right)^{1+\eta_H} + \alpha_H^W\beta\pi_{H,t+1}^{W\theta_H^W(1+\eta_H)}x_{1,t+1}^W$$

$$x_{1,t}^{WN} = \frac{\theta_{HN}^W}{(\theta_{HN}^W-1)}\left(\frac{L_{N,t}^O}{1-a_T}\right)^{1+\eta_H} + \alpha_{HN}^W\beta\pi_{N,t+1}^{W\theta_{HN}^W(1+\eta_H)}x_{1,t+1}^{WN}$$

$$x_{2,t}^W = (1-\tau_H^W)C_t^{O-\sigma_H}\frac{W_{H,t}}{P_{T,t}}\frac{P_{T,t}}{P_t}\left(\frac{L_{T,t}^O}{a_T}\right) + \alpha_H^W\beta\pi_{H,t+1}^{W\theta_H^W-1}x_{2,t+1}^W$$

$$x_{2,t}^{WN} = (1-\tau_{HN}^{W})C_t^{O-\sigma_H}\frac{W_{N,t}}{P_t}\left(\frac{L_{N,t}^{O}}{1-a_T}\right) + \alpha_{HN}^{W}\beta\pi_{N,t+1}^{W\theta_{HN}^{W}-1}x_{2,t+1}^{WN}$$

$$\pi_{H,t}^{W} = \frac{W_{H,t}}{P_{T,t}}\frac{P_{T,t-1}}{W_{H,t-1}}\frac{P_{H,t-1}}{P_{T,t-1}}\frac{P_{T,t}}{P_{H,t}}\pi_{H,t}$$

$$\pi_{N,t}^{W} = \frac{W_{N,t}}{P_t}\frac{P_{t-1}}{W_{N,t-1}}\frac{P_{N,t-1}}{P_{t-1}}\frac{P_t}{P_{N,t}}\pi_{N,t}$$

$$\frac{x_{1,t}^{W*}}{x_{2,t}^{W*}} = \left(\frac{1-\alpha_F^{W}\pi_{F,t}^{W*\theta_F^{W}-1}}{1-\alpha_F^{W}}\right)^{\frac{1+\theta_F^{W}\eta_F}{1-\theta_F^{W}}}$$

$$\frac{x_{1,t}^{WN*}}{x_{2,t}^{WN*}} = \left(\frac{1-\alpha_{FN}^{W}\pi_{N,t}^{W*\theta_{FN}^{W}-1}}{1-\alpha_{FN}^{W}}\right)^{\frac{1+\theta_{FN}^{W}\eta_F}{1-\theta_{FN}^{W}}}$$

$$x_{1,t}^{W*} = \frac{\theta_F^{W}}{(\theta_F^{W}-1)}\left(\frac{L_{T,t}^{O*}}{a_T^{*}}\right)^{1+\eta_F} + \alpha_F^{W}\beta\pi_{F,t+1}^{W*\theta_F^{W}(1+\eta_F)}x_{1,t+1}^{W*}$$

$$x_{1,t}^{WN*} = \frac{\theta_{FN}^{W}}{(\theta_{FN}^{W}-1)}\left(\frac{L_{N,t}^{O*}}{1-a_T^{*}}\right)^{1+\eta_F} + \alpha_{FN}^{W}\beta\pi_{N,t+1}^{W*\theta_{FN}^{W}(1+\eta_F)}x_{1,t+1}^{WN*}$$

$$x_{2,t}^{W*} = (1-\tau_F^{W})C_t^{O*-\sigma_H}\frac{W_{F,t}^{*}}{P_{T,t}^{*}}\frac{P_{T,t}^{*}}{P_t^{*}}\left(\frac{L_{T,t}^{O*}}{a_T^{*}}\right) + \alpha_H^{W}\beta\pi_{H,t+1}^{W\theta_H^{W}-1}x_{2,t+1}^{W*}$$

$$x_{2,t}^{WN*} = (1-\tau_{FN}^{W})C_t^{O*-\sigma_F}\frac{W_{N,t}^{*}}{P_t^{*}}\left(\frac{L_{N,t}^{O*}}{1-a_T^{*}}\right) + \alpha_{FN}^{W}\beta\pi_{N,t+1}^{W*\theta_{FN}^{W}-1}x_{2,t+1}^{WN*}$$

$$\pi_{F,t}^{W*} = \frac{W_{F,t}^{*}}{P_{T,t}^{*}}\frac{P_{T,t-1}^{*}}{W_{F,t-1}^{*}}\frac{P_{F,t-1}^{*}}{P_{T,t-1}^{*}}\frac{P_{T,t}^{*}}{P_{F,t}^{*}}\pi_{F,t}^{*}$$

$$\pi_{N,t}^{W*} = \frac{W_{N,t}^{*}}{P_t^{*}}\frac{P_{t-1}^{*}}{W_{N,t-1}^{*}}\frac{P_{N,t-1}^{*}}{P_{t-1}^{*}}\frac{P_t^{*}}{P_{N,t}^{*}}\pi_{N,t}^{*}$$

Ricardian households:

$$\beta E_t\frac{C_{t+1}^{O-\sigma_H}}{C_t^{O-\sigma_H}}\frac{(1+i_t)}{\pi_{t+1}} = 1$$

$$\beta E_t \frac{C_{t+1}^{O-\sigma_H}}{C_t^{O-\sigma_H}} \frac{(1+i_t^*)}{\pi_{t+1}} \frac{Q_{t+1}}{Q_t} = \frac{1}{\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)}$$

$$\beta E_t \frac{C_{t+1}^{O*-\sigma_F}}{C_t^{O*-\sigma_F}} \frac{(1+i_t^*)}{\pi_{t+1}^*} = 1$$

Rule-of-thumb households:

$$C_t^R = \left[a_H^H \left(\frac{W_{H,t}}{P_t}\right)^{\frac{1+\eta_H}{\eta_H}} + (1-a_H^H)\left(\frac{W_{N,t}}{P_t}\right)^{\frac{1+\eta_H}{\eta_H}} \right]^{\frac{\eta_H}{\eta_H+\sigma_H}}$$

$$\frac{\left(\frac{L_{k,t}^R}{a_k}\right)^{\eta_H}}{C_t^{R-\sigma}} = \frac{W_{k,t}}{P_t}, \qquad k = H, N$$

$$C_t^{R*} = \left[a_T^* \left(\frac{W_{T,t}^*}{P_t^*}\right)^{\frac{1+\eta_F}{\eta_F}} + (1-a_T^*)\left(\frac{W_{N,t}^*}{P_t^*}\right)^{\frac{1+\eta_F}{\eta_F}} \right]^{\frac{\eta_F}{\eta_F+\sigma_F}}$$

$$\frac{\left(\frac{L_{k,t}^{R*}}{a_k^*}\right)^{\eta_F}}{C_t^{R*-\sigma}} = \frac{W_{k,t}^*}{P_t^*}, \qquad k = H, N$$

Aggregation across households:

$$L_{k,t} = (1-\lambda_H^R)L_{k,t}^O + \lambda_H^R L_{k,t}^R, \qquad k = H, N$$

$$C_t = (1-\lambda_H^R)C_t^O + \lambda_H^R C_t^R$$

$$L_{k,t}^* = (1-\lambda_F^R)L_{k,t}^{O*} + \lambda_F^R L_{k,t}^{R*}, \qquad k = H, N$$

$$C_t^* = (1-\lambda_F^R)C_t^{O*} + \lambda_F^R C_t^{R*}$$

Price indices:

$$P_t = \left[a_T P_{T,t}^{1-\varphi_H^N} + (1-a_T) P_{N,t}^{1-\varphi_H^N} \right]^{\frac{1}{1-\varphi_H^N}}$$

$$P_t^* = \left[a_T^* P_{T,t}^{*1-\varphi_F^N} + (1-a_T^*) P_{N,t}^{*1-\varphi_F^N} \right]^{\frac{1}{1-\varphi_F^N}}$$

$$P_{T,t} = \left[a_H P_{H,t}^{1-\varphi_H} + (1-a_H) P_{F,t}^{1-\varphi_H}\right]^{\frac{1}{1-\varphi_H}}$$

$$P_{T,t}^{*} = \left[a_F P_{F,t}^{*1-\varphi_F} + (1-a_F) P_{H,t}^{*1-\varphi_F}\right]^{\frac{1}{1-\varphi_F}}$$

Exchange rate definition:

$$Q_t = \left(\frac{s_t P_{T,t}^{*}}{P_{T,t}}\right)\left(\frac{P_{T,t}}{P_t}\right) \left(\frac{P_{T,t}^{*}}{P_t^{*}}\right)^{-1}$$

Production functions:

$$\begin{aligned} Disp_{T,t} Y_{T,t} &= L_{T,t} \\ Disp_{T,t}^{*} Y_{T,t}^{*} &= L_{T,t}^{*}, \\ Disp_{N,t} C_{N,t} &= L_{N,t} \\ Disp_{N,t}^{*} C_{N,t}^{*} &= L_{N,t}^{*} \end{aligned}$$

Resource constraint:

$$C_t + \frac{s_t B_{F,t}}{P_t(1+i_t^{*})\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)} = Y_t + \frac{s_t B_{F,t-1}}{P_t}$$

Monetary policy rules:

$$\log\left(\frac{i_t}{\bar{\imath}}\right) = (1-\alpha_H^{FIX})\left[\alpha_H^{R}\log\left(\frac{i_{t-1}}{\bar{\imath}}\right) + \alpha_H^{\pi}\log\left(\frac{\pi_t}{\bar{\pi}}\right)\right] + \alpha_H^{FIX}\log\left(\frac{i_t^{*}\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)}{\bar{\imath}}\right) + \psi_t^{I}$$

$$\log\left(\frac{i_t^{*}}{\bar{\imath}}\right) = (1-\alpha_F^{FIX})\left[\alpha_F^{R}\log\left(\frac{i_{t-1}^{*}}{\bar{\imath}}\right) + \alpha_F^{\pi}\log\left(\frac{\pi_t^{*}}{\bar{\pi}}\right)\right] + \alpha_F^{FIX}\log\left(\frac{i_t}{\bar{\imath}\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)}\right) + \psi_t^{I*}$$

Appendix B. Results with capital and investment

This appendix describes an extended version of the model figuring in Section 2, which includes investment and capital, and reports the main results from that model.

B.1. The model with capital

The model is similar to the model described in Section 2, but we now assume that firms use capital as a factor of production alongside labour and that optimizing households may invest in capital (as well as bonds, domestic and international, as previously). We here discuss how the introduction of capital affects the equilibrium of the domestic economy, but the foreign economy is affected in a similar fashion because the two countries are symmetric in terms of their structure.

Output of domestic firm h in sector k is $y_{k,t}(h) = \mathrm{CAP}_{\mathrm{k,t}}(h)^{ks}\, l_{k,t}(h)^{1-ks}$, $\mathrm{k} = \{\mathrm{N}, \mathrm{H}\}$, where $\mathrm{CAP}_{\mathrm{k,t}}$ denotes capital in sector k available for production purposes at time t and ks denotes the capital share. Firms decide how much labour and capital to utilise every period, and the equilibrium ensures that the marginal cost of using capital equals the marginal cost of labour such that in aggregate $\frac{\mathrm{CAP}_{\mathrm{k,t}}}{\mathrm{L}_{\mathrm{k,t}}} = \frac{ks}{1-ks}\frac{\mathrm{W}_{\mathrm{k,t}}}{\mathrm{r}_{\mathrm{k,t}}}$, $\mathrm{k} = \{\mathrm{N}, \mathrm{H}\}$ where $\mathrm{r}_{\mathrm{k,t}}$ is the rental rate of capital in sector k.

Our approach to introducing capital in this two-sector model is similar to that taken by Gali et al (2007) in their closed-economy framework. The optimizing households are assumed to own the entire stock of capital. They rent out the capital stock to domestic firms in the traded and non-traded sectors, at the rental rate $\mathrm{r}_{\mathrm{k,t}}$, $\mathrm{k} = \{\mathrm{N}, \mathrm{H}\}$. Capital in sector k accumulates according to the following law of motion:

$$\mathrm{CAP}_{\mathrm{k,t+1}} = (1 - \delta^{CAP})\mathrm{CAP}_{\mathrm{k,t}} + \mathrm{INV}_{\mathrm{k,t}} - \frac{\zeta}{2}\left(\frac{\mathrm{INV}_{\mathrm{k,t}}}{\mathrm{INV}_{\mathrm{k,t-1}}} - 1\right)^2, \mathrm{k} = \{\mathrm{N}, \mathrm{H}\}$$

where $\mathrm{INV}_{\mathrm{k,t}}$ denotes investment in sector k at time t. δ^{CAP} is the rate of depreciation of capital and ζ determines the degree to which quadratic investment adjustment costs operate. These costs are modelled as in Christiano, Eichenbaum and Evans (2005) and Schmitt-Grohe and Uribe (2012).

Every period, optimising households use their labour income, their income from renting capital to firms, their wealth accumulated in domestic and foreign bonds (denominated in Foreign currency), and profits of firms in the domestic economy to purchase consumption, investment and both domestically issued bonds and Foreign bonds and pay lump-sum taxes. To ensure that all households have the same disposable income in steady state, we impose a lump-sum tax on optimizing households, TR. The proceeds of that tax are transferred to rule-of-thumb households.

In the Home country, the representative optimising household budget constraint thus amounts to:

$$\mathrm{C_t^O + INV_{N,t} + INV_{T,t} + \frac{B_{H,t}}{P_t(1+i_t)} + \frac{s_t B_{F,t}}{P_t(1+i_t^*)\Phi\left(\frac{s_t B_{F,t}}{P_t}\right)} + T_t}$$
$$\mathrm{= \left(1-\tau_{H,H}^{w}\right)\frac{W_{H,t}}{P_t}L_{H,t}^{O} + \left(1-\tau_{N,H}^{w}\right)\frac{W_{N,t}}{P_t}L_{N,t}^{O} + r_{N,t}CAP_{N,t} + r_{H,t}CAP_{T,t}}$$
$$\mathrm{+ \frac{B_{H,t-1}}{P_t} + \frac{s_t B_{F,t-1}}{P_t} + PR_t - TR}$$

The optimising households maximize their welfare subject to this budget constraint as well as the laws of motion for capital. The optimising households' first-order conditions with respect to next period's capital and current investment in sector *k* yield the following additional aggregate equilibrium equations:

$$\lambda_t^k = (1-\delta^{CAP})\frac{-C_t^{O-\sigma} + \beta E_t C_{t+1}^{O-\sigma}\frac{r_{k,t+1}}{P_{t+1}}\left[\zeta\left(\frac{INV_{k,t}}{INV_{k,t-1}}-1\right)\frac{1}{INV_{k,t-1}}-1\right]}{(1-\delta^{CAP})\left[1-\zeta\left(\frac{INV_{k,t}}{INV_{k,t-1}}-1\right)\frac{1}{INV_{k,t-1}}\right]+\zeta\left(\frac{INV_{k,t+1}}{INV_{k,t}}-1\right)\frac{INV_{k,t+1}}{{INV_{k,t}}^2}}$$
$$+\beta E_t C_{t+1}^{O-\sigma}\frac{r_{k,t+1}}{P_{t+1}}$$

$$-C_t^{O-\sigma} = \lambda_t^k\left[1-\zeta\left(\frac{INV_{k,t}}{INV_{k,t-1}}-1\right)\frac{1}{INV_{k,t-1}}\right] + \beta E_t\lambda_{t+1}^k\left[\zeta\left(\frac{INV_{k,t+1}}{INV_{k,t}}-1\right)\frac{INV_{k,t+1}}{{INV_{k,t}}^2}\right]$$

where λ_t^k is the Lagrangian multiplier associated with the law of motion for capital.

The rule-of-thumb households' problem changes only as a result of the transfer which is constant and ensures that steady state consumption and labour decisions are similar for both types of households.

We also now include investment spending (inclusive of the investment adjustment costs) into the equation describing the net foreign asset position, and adjust our GDP computations by including investment as an expenditure component.

B.2. Main results

The model becomes relatively complex and includes more than 100 equilibrium equations when we include capital and investment. Our analysis is therefore restricted to a symmetric equilibrium with the calibration figuring in Table B.1. below.

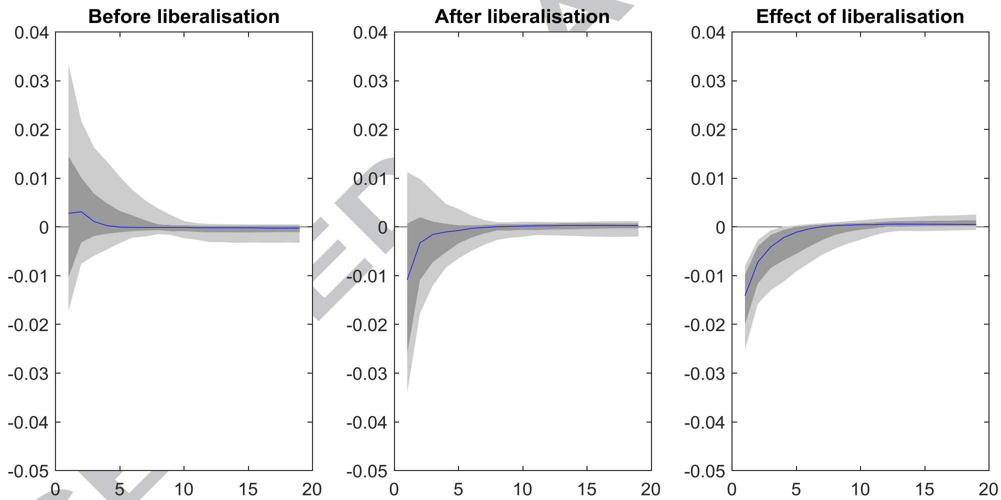
Table B.1.

Description	Parameter	Range
Population in Home country	n	0.1
Discount factor	β	0.99
Yield sensitivity to external debt	δ	0.01
Capital share	ks	1/3
Rate of depreciation of capital	δ^{CAP}	0.025
Investment adjustment cost parameter	ζ	5
Home/Foreign country parameters:		
Degree of openness	op_H, op_F	[0.2,0.4]
Inverse of the Frisch elasticity of labour supply	η_H, η_F	[1.5,2.5]
Risk aversion coefficient	σ_H, σ_F	[1,1.2]
Price stickiness parameter in sector k	α_H^k, α_F^k	[0.25,0.9]
Wage stickiness parameter in sector k	$\alpha_{k,H}^w, \alpha_{k,F}^w$	[0.25,0.9]
Intra-temporal elasticity of substitution in sector k	θ_H^k, θ_F^k	[3,11]
Elasticity of substitution between labour inputs in sector k	$\theta_{k,H}^w, \theta_{k,F}^w$	[3,11]
Elasticity of substitution between traded H and F goods	ϕ_H, ϕ_F	[0.5,1]
Elasticity of substitution between traded and non-traded goods	φ_H^N, φ_F^N	[0.4,1]
Proportion of rule of thumb households	λ_H^R, λ_F^R	[0.1,0.4]
Home/Foreign monetary policy rule parameters:		
Interest rate persistence	α_H^R, α_F^R	[0.5,0.9]
Interest rate sensitivity to CPI inflation	$\alpha_H^\pi, \alpha_F^\pi$	[1.2,3]
Degree of exchange rate targeting	$\alpha_H^{FIX}, \alpha_F^{FIX}$	[0,0.3]

In our analysis of the effects of financial regulation on the effect of monetary policy on the current account, we vary the proportion of rule-of-thumb households from 0.4 to 0.1, as before. The main results from our analysis using the simpler model without capital hold through when we add capital to our model. The left-hand side of Figure B.1 shows that the CA/GDP response to a monetary policy expansion (a fall in the interest rate of

1pp) is positive in economies where financial markets are not very liberalised (i.e. the proportion of rule-of-thumb households is high, see the left hand-side plot below) but becomes smaller in economies with higher liberalisation and is negative when the degree of financial market liberalisation is high (see middle plot). Contrary to the model without capital, the response is more hump-shaped for lower degrees of liberalisation, and for higher degrees of liberalisation, the response is sometimes J-curved. However, this does not change our main result pictured on the right-hand side plot: The effect of liberalisation is to reduce the CA/GDP response to a given monetary policy expansion: the current account is more likely to go into deficit following a monetary policy expansion when financial markets are liberalised.

Figure B.1. The effect of financial liberalisation on the monetary policy transmission to the current account



Appendix C. More details on the varying-coefficient Bayesian Panel VAR model

Previous work has adopted three different ways of estimating panel VAR models with the structure as set out in **(1) – (4)**. Abritti and Weber (2010) and Towbin and Weber (2013) assume that $\boldsymbol{u}_{\boldsymbol{B}c,\tau} = \boldsymbol{0}$, which means that $\boldsymbol{B}_{c,\tau}$ is a deterministic function of the vector of exogenous coefficients. In that case equations **(2), (3)** and **(4)** can be substituted back into equation **(1)** and the model can be easily estimated by OLS, equation by equation. But there is one drawback: unlike with stochastically varying coefficients, this assumption may result in smaller confidence bands and hence misleading inference, as demonstrated in the commodity price shock application of Wieladek (2016).

Sa, Towbin and Wieladek (2014) use the mean group estimator to allow for stochastic variation in $\boldsymbol{B}_{c,\tau}$. But to the extent that this approach requires estimation country-by-country, modelling variation in coefficients as a set of more than two exogenous variables is typically not feasible, even in moderately sized VARs, due to degrees of freedom considerations. Wieladek (2016) proposes Bayesian shrinkage for estimating this type of model by extending the hierarchical linear model approach presented in Jarocinski (2010). This is similar to the Litterman (1986) prior assumption popular in economic forecasting, but rather than shrinking towards a random walk, coefficients are shrunk towards a set of explanatory variables, $\boldsymbol{B}_{c,\tau}$. $\boldsymbol{B}_{c,\tau}$ is modelled as a stochastic function of multiple explanatory variables. Importantly, $\boldsymbol{B}_{c,\tau}$ can vary at different frequencies than the actual data. Due to all of these advantages, this is the approach that we choose to adopt. In particular, we assume the following priors for $\boldsymbol{B}_{c,\tau}$ and $\boldsymbol{A}_{c,\tau}$:

$$\boldsymbol{p}(\boldsymbol{B}_{c,\tau} \mid \boldsymbol{D}_{c,\tau}\boldsymbol{\delta}_B, \boldsymbol{\Lambda}_{Bc}) = \boldsymbol{N}(\boldsymbol{D}_{c,\tau}\boldsymbol{\delta}_B, \boldsymbol{\Lambda}_{Bc}) \tag{5}$$

$$\boldsymbol{p}(\boldsymbol{A}_{c,\tau} \mid \boldsymbol{D}_{c,\tau}\boldsymbol{\delta}_A, \boldsymbol{\Lambda}_{Ac}) = \boldsymbol{N}(\boldsymbol{D}_{c,\tau}\boldsymbol{\delta}_A, \boldsymbol{\Lambda}_{Ac}) \tag{6}$$

where $\boldsymbol{\delta}_B, \boldsymbol{\delta}_A$ is a matrix of pooled coefficients across countries, which relate the predetermined variables $\boldsymbol{D}_{c,t}$ to the individual country coefficients $\boldsymbol{B}_{c,\tau}, \boldsymbol{A}_{c,\tau}$, with the variances $\boldsymbol{\Lambda}_{Bc}, \boldsymbol{\Lambda}_{Ac}$ determining the tightness of these priors.[24] We follow Jarocinski (2010) and parameterize $\boldsymbol{\Lambda}_{Bc} = \boldsymbol{\lambda}_B\boldsymbol{L}_{Bc}$ and $\boldsymbol{\Lambda}_{Ac} = \boldsymbol{\lambda}_A\boldsymbol{L}_{Ac}$. $\boldsymbol{\lambda}_B$ and $\boldsymbol{\lambda}_A$ are treated as hyper parameters and are estimated from the data, based on an inverse gamma distribution, while $\boldsymbol{L}_{Bc}$ and $\boldsymbol{L}_{Ac}$, as explained in detail below, are calibrated pre-estimation. The greater $\boldsymbol{\lambda}_B$ and $\boldsymbol{\lambda}_A$ the larger the degree to which the country-specific coefficients are allowed to differ from the common mean. If $\boldsymbol{\lambda}_B \rightarrow \boldsymbol{\infty}$ and $\boldsymbol{\lambda}_A \rightarrow \boldsymbol{\infty}$, this approach will lead to country-by-country estimates, while $\boldsymbol{\lambda}_B = \boldsymbol{0}$ and $\boldsymbol{\lambda}_A = \boldsymbol{0}$ implies pooling across all countries. The parameterisation of $\boldsymbol{\Lambda}_{Bc}$ and $\boldsymbol{\Lambda}_{Ac}$ in this manner has the econometrically convenient property that it is necessary only to estimate two hyper-parameters $\boldsymbol{\lambda}_B$ and $\boldsymbol{\lambda}_A$

[24] In our application, $\boldsymbol{D}_{c,t}$ contains indices of exchange rate, financial, labour and product market liberalisation for country $\boldsymbol{c}$ at time τ.

to determine the degree of heterogeneity in the lagged dependent and contemporaneous coefficients, respectively. But there is of course one drawback: the coefficients in $\boldsymbol{B_{c,\tau}}$ and $\boldsymbol{A_{c,\tau}}$ may have different magnitudes. In specifying a single parameter that determines the degree of heterogeneity, there is therefore the risk that some coefficients are allowed to differ from the common mean by a small fraction of their own size, while others can differ by orders of magnitude. Following the approach proposed in Jarocinski (2010) and Wieladek (2016) and a procedure analogous to the Litterman (1986) prior, $\boldsymbol{L_{Bc}}$ is a matrix of scaling factors used to address this problem. In particular, $\boldsymbol{L_{Bc}(k,n)} = \frac{\boldsymbol{\sigma_{cn}^2}}{\boldsymbol{\sigma_{ck}^2}}$, where $\boldsymbol{c}$ is the country, $\boldsymbol{n}$ the equation and $\boldsymbol{k}$ the number of the variable regardless of lag. $\boldsymbol{\sigma_{cn}^2}$ is the estimated variance of the residuals of a univariate auto-regression of the endogenous variable in equation $\boldsymbol{n}$, of the same order as the VAR, and is obtained pre-estimation. $\boldsymbol{\sigma_{ck}^2}$ is the corresponding variance for variable $\boldsymbol{k}$ and obtained in an identical manner. $\boldsymbol{L_{Ac}}$ is obtained in a similar manner. To the extent that unexpected movements in variables will reflect the difference in the size of VAR coefficients, scaling by this ratio of variances allows us to address this issue.

Wieladek (2016) shows that based on these assumptions, the joint posterior of the model can be written as:

$$\prod_c \prod_t |\boldsymbol{\Sigma_c}| \exp\left(-\frac{1}{2} \sum_t \sum_c (\boldsymbol{y_{c,t}} - \boldsymbol{\widetilde{X}_{c,t}\beta_{c,\tau}})' (\boldsymbol{A_{c,\tau}'\Sigma_c A_{c,\tau}})^{-1} (\boldsymbol{y_{c,t}} - \boldsymbol{\widetilde{X}_{c,t}\beta_{c,\tau}}) \right)$$

$$\boldsymbol{\lambda_B}^{-\frac{\boldsymbol{\Upsilon CNK}}{2}} \boldsymbol{exp}(-\frac{\boldsymbol{1}}{\boldsymbol{2}} \sum_{\boldsymbol{\tau}} \sum_{\boldsymbol{c}} (\boldsymbol{\beta_{c,\tau}} - \boldsymbol{\overline{\beta}_{c,\tau}})' \boldsymbol{L_{Bc}^{-1}} \boldsymbol{\lambda_B}^{-\boldsymbol{1}} (\boldsymbol{\beta_{c,\tau}} - \boldsymbol{\overline{\beta}_{c,\tau}})) \prod_c \prod_{\boldsymbol{\tau}} |\boldsymbol{\Sigma_c}|^{-\frac{N+1}{2}} \boldsymbol{\lambda_B}^{-\frac{v+2}{2}} \boldsymbol{exp}(-\frac{\boldsymbol{1}}{\boldsymbol{2}} \frac{\boldsymbol{s}}{\boldsymbol{\lambda_B}})$$

$$\boldsymbol{\lambda_A}^{-\frac{\boldsymbol{\Upsilon N(N-1)}}{2}} \boldsymbol{exp}(-\frac{\boldsymbol{1}}{\boldsymbol{2}} \sum_{\boldsymbol{\tau}} \sum_{\boldsymbol{c}} (\boldsymbol{a_{c,\tau}} - \boldsymbol{a_{c,\tau}})' \boldsymbol{L_{Ac}^{-1}} \boldsymbol{\lambda_A}^{-\boldsymbol{1}} (\boldsymbol{a_{c,\tau}} - \boldsymbol{\overline{a}_{c,\tau}})) \prod_c \prod_{\boldsymbol{\tau}} |\boldsymbol{\Sigma_c}|^{-\frac{N+1}{2}} \boldsymbol{\lambda_A}^{-\frac{v+2}{2}} \boldsymbol{exp}(-\frac{\boldsymbol{1}}{\boldsymbol{2}} \frac{\boldsymbol{s}}{\boldsymbol{\lambda_A}})$$

where $\boldsymbol{\widetilde{X}_{c,t}} \equiv \boldsymbol{I_N} \otimes \boldsymbol{X_{c,t}}$, $\boldsymbol{y_{c,t}} \equiv \boldsymbol{vec(Y_{c,t})}$, $\boldsymbol{\beta_{c,\tau}} \equiv \boldsymbol{vec(B_{c,\tau})}$, $\boldsymbol{\overline{\beta}_{c,\tau}} \equiv \boldsymbol{vec(D_{c,\tau}\delta_B)}$, $\boldsymbol{a_{c,\tau}} \equiv \boldsymbol{vec(A_{c,\tau})}$, $\boldsymbol{\overline{a}_{c,\tau}} \equiv \boldsymbol{vec(D_{c,\tau}\delta_A)}$ and $\boldsymbol{\Upsilon} = \frac{\boldsymbol{T}}{\Xi}$. $\boldsymbol{T}$ is the total number of time series observations and $\boldsymbol{\Upsilon}$ is the total number of time periods that $\boldsymbol{B_{c,\tau}}$ and $\boldsymbol{A_{c,\tau}}$ are allowed to vary for. As explained above, we set $\boldsymbol{\Xi} = \mathbf{20},$ which means that with a $\boldsymbol{T}$ of 120, $\boldsymbol{\Upsilon} = \mathbf{6}$. Wieladek (2016) shows how to derive the conditional distributions for the Gibbs sampler of this model. For brevity, we outline them below and refer the reader to his paper for more details.

The country-specific VAR coefficients $\boldsymbol{\beta_{c,\tau}}$ are drawn from:

$$p(\boldsymbol{\beta_{c,\tau}} \mid \overline{\boldsymbol{\beta}}_{c,\tau}, \boldsymbol{Y_c}, \boldsymbol{\Lambda_{Bc}}) = \boldsymbol{N}((\boldsymbol{G_c})^{-1}\left(\left(\boldsymbol{A}'_{c,\tau}\boldsymbol{\Sigma_c}\boldsymbol{A_{c,\tau}}\right)^{-1} \otimes \boldsymbol{X}'_{c,t}\right)\boldsymbol{y_{c,t}} + \boldsymbol{L}_{Bc}^{-1}\boldsymbol{\lambda_B}^{-1}\overline{\boldsymbol{\beta}}_{c,\tau}, (\boldsymbol{G_c}^{-1})) \quad (7)$$

where $\boldsymbol{G_c} = \left(\boldsymbol{A}'_{c,\tau}\boldsymbol{\Sigma_c}\boldsymbol{A_{c,\tau}}\right)^{-1} \otimes \boldsymbol{X}'_{c,t}\boldsymbol{X_{c,t}} + \boldsymbol{L}_{Bc}^{-1}\boldsymbol{\lambda_B}^{-1}$. $\boldsymbol{\delta_B}$ is drawn from:

$$p(\boldsymbol{\delta_B} \mid \boldsymbol{\beta_{c,\tau}}, \boldsymbol{\Lambda_{Bc}}) = \boldsymbol{N}((\textstyle\sum_c\sum_\tau \boldsymbol{D}'_{c,\tau}\boldsymbol{\Lambda}_{Bc}^{-1}\boldsymbol{D_{c,\tau}})^{-1}\sum_c\sum_\tau \boldsymbol{D}'_{c,\tau}\boldsymbol{\Lambda}_{Bc}^{-1}\boldsymbol{\beta_{c,\tau}}, (\sum_c\sum_\tau \boldsymbol{D}'_{c,\tau}\boldsymbol{\Lambda}_{Bc}^{-1}\boldsymbol{D_{c,\tau}})^{-1}) \quad (8)$$

$\boldsymbol{\lambda_B}$ is treated as a hyper parameter and drawn from the following inverse gamma 2 distribution:

$$p(\boldsymbol{\lambda_B} \mid \overline{\boldsymbol{\beta}}, \boldsymbol{\beta_c}, \boldsymbol{L_c^{-1}}) = \boldsymbol{IG_2}(\boldsymbol{s} + \textstyle\sum_\tau\sum_c(\boldsymbol{\beta_{c,\tau}} - \overline{\boldsymbol{\beta}}_{c,\tau})'\boldsymbol{L}_{Bc}^{-1}\boldsymbol{\lambda_B}^{-1}(\boldsymbol{\beta_{c,\tau}} - \overline{\boldsymbol{\beta}}_{c,\tau}), \boldsymbol{\Upsilon CNK} + \boldsymbol{v}) \quad (9)$$

A completely non-informative prior with s and v set to 0 results in an improper posterior in this case. We therefore set both of the quantities to very small positive numbers, which is equivalent to assuming a weakly informative prior. But it is important to point out that $\boldsymbol{\lambda}$ is estimated from the total number of coefficients that this prior is applied to, namely the product of country (**C**), equations (**N**) and total number of coefficients in each equation (**K**). Given this large number of effective units, any weakly informative prior will be dominated by the data.

Similarly, given that $\boldsymbol{A_{c,\tau}}$ is lower-triangular with ones on the diagonal, it can be shown that $\boldsymbol{a}_{c,\tau}^{j}$, where j refers to the equation, can be drawn equation by equation from:

$$p(\boldsymbol{a}_{c,\tau}^{j} \mid \overline{\boldsymbol{a}}_{c,\tau}^{j}, \boldsymbol{E_c}, \boldsymbol{\Lambda_{Ac}}) = \boldsymbol{N}(\boldsymbol{F_c^{-1}}(\boldsymbol{\Sigma_c^{-1}} \otimes \boldsymbol{EJ}'_{c,t})\boldsymbol{e_{c,t}} + \boldsymbol{L}_{Ac}^{-1}\boldsymbol{\lambda_A}^{-1}\overline{\boldsymbol{a}}_{c,t}^{j}, \boldsymbol{F_c^{-1}}) \quad (10)$$

where $\boldsymbol{F_c} = \boldsymbol{\Sigma_c^{-1}} \otimes \boldsymbol{EJ}'_{c,t}\boldsymbol{EJ_{c,t}} + \boldsymbol{L}_{Ac}^{-1}\boldsymbol{\lambda_A}^{-1}$, $\boldsymbol{e_{c,t}}$ is the error term of equation j and $\boldsymbol{EJ}'_{c,t}$ contains all of the other relevant $\boldsymbol{e_{c,t}}$'s as explanatory variables for that equation. Given that $\boldsymbol{A_{c,\tau}}$ is lower-triangular, this means that in the case of the second equation, $\boldsymbol{EJ}'_{c,t}$ will consist of one other error term, in the case of the third equation of two ,etc. $\boldsymbol{\delta_A}$ is drawn from:

$$p(\boldsymbol{\delta_A} \mid \boldsymbol{a_{c,\tau}}, \boldsymbol{\Lambda_{Ac}}) = \boldsymbol{N}((\textstyle\sum_c\sum_\tau \boldsymbol{D}'_{c,\tau}\boldsymbol{\Lambda}_{Ac}^{-1}\boldsymbol{D_{c,\tau}})^{-1}\sum_c\sum_\tau \boldsymbol{D}'_{c,\tau}\boldsymbol{\Lambda}_{Ac}^{-1}\boldsymbol{a_{c,\tau}}, (\sum_c\sum_\tau \boldsymbol{D}'_{c,\tau}\boldsymbol{\Lambda}_{Bc}^{-1}\boldsymbol{D_{c,\tau}})^{-1}) \quad (11)$$

$\boldsymbol{\lambda_A}$ is treated as a hyper parameter and drawn from the following inverse gamma 2 distribution:

$$\boldsymbol{p}(\boldsymbol{\lambda}_A \mid \overline{\boldsymbol{a}}_{c,\tau}, \boldsymbol{a}_{c,\tau}) = \boldsymbol{IG}_2(\boldsymbol{s} + \sum_\tau \sum_c (\boldsymbol{a}_{c,\tau} - \overline{\boldsymbol{a}}_{c,\tau})' \boldsymbol{L}_{Ac}^{-1} (\boldsymbol{a}_{c,\tau} - \overline{\boldsymbol{a}}_{c,\tau}), \boldsymbol{YN}(\boldsymbol{N}-\mathbf{1})/2 + \boldsymbol{v}) \tag{12}$$

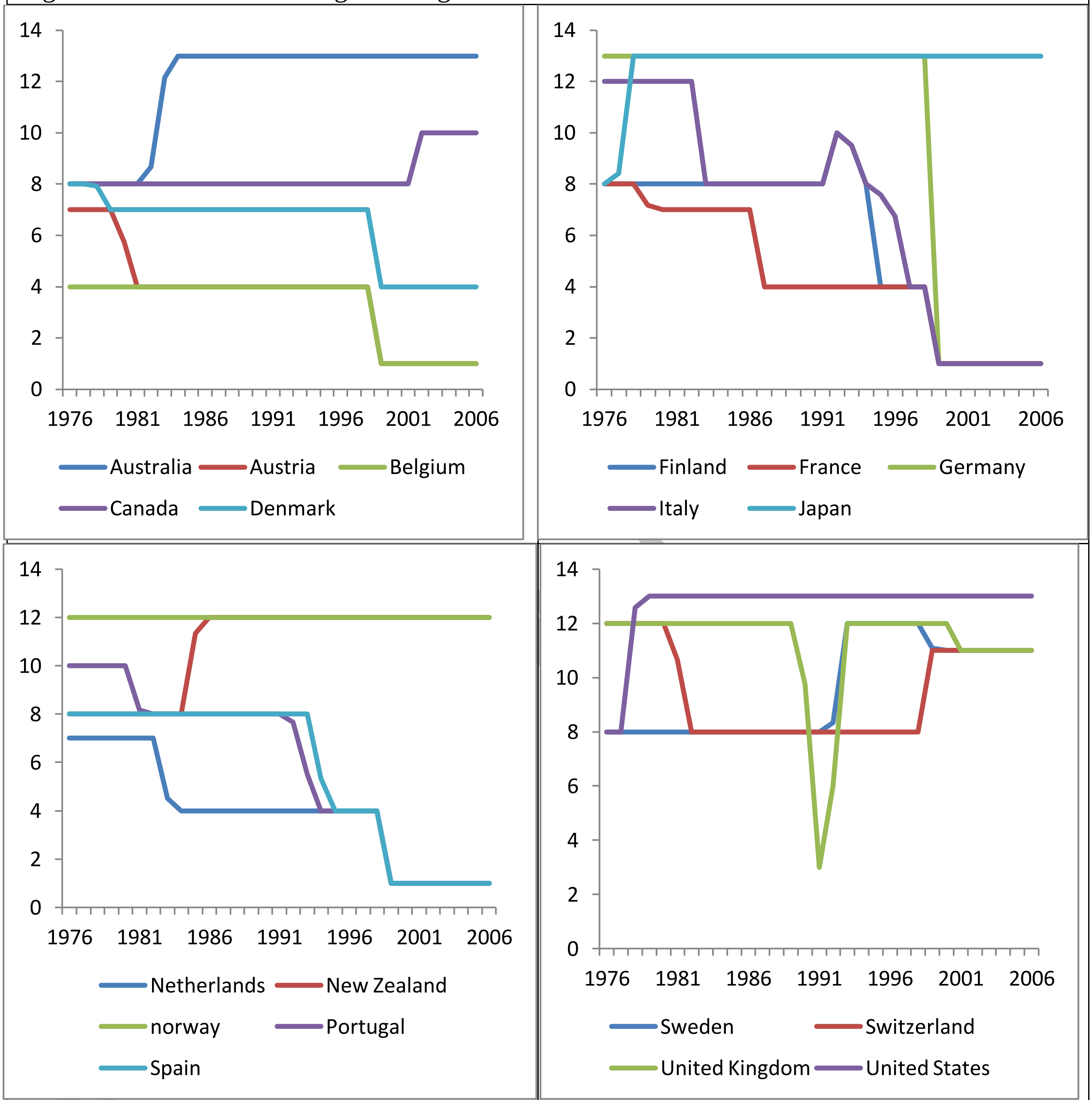
Finally, the country-specific variance matrix of the residuals, $\boldsymbol{\Sigma_c}$, is drawn from an inverse-Wishart distribution:

$$\boldsymbol{p}(\boldsymbol{\Sigma}_c \mid A_{c,\tau}^{-1}, \boldsymbol{\beta}_{c,\tau}) = \boldsymbol{IW}(\boldsymbol{U}_c' \boldsymbol{U}_c, \boldsymbol{T}_c) \tag{13}$$

where $\boldsymbol{U_c} = [\boldsymbol{U}_{c,1} \dots \boldsymbol{U}_{c,T}]'$, $\boldsymbol{U}_{c,t} = \boldsymbol{A}_{c,\tau}^{-1} \boldsymbol{E}_{c,t}$ and $\boldsymbol{T_c}$ is the number of observations for each country. The model is estimated by repeatedly drawing from the posteriors of the Gibbs sampling chain in (7) – (13) 150,000 times, discarding the first 50,000 draws as burn-in and retaining every 100th of the remaining draws for inference.

The VAR also controls for exchange rate regime. The figure below shows the indicator of exchange rate regime flexibility that we use for each of the 19 countries in our study. The index is taken from Ilzetzki, Reinhart and Rogoff (2017).

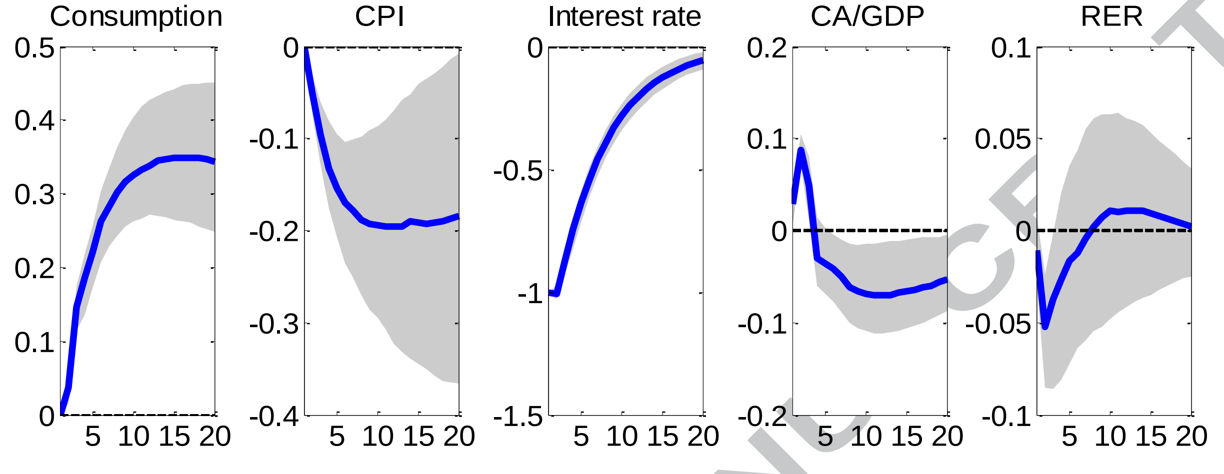
Figure C.1: Index of exchange rate regime in 19 OECD countries



Sources & Notes: Ilzetzki, Reinhart and Rogoff (2017). Higher values indicate greater flexibility.

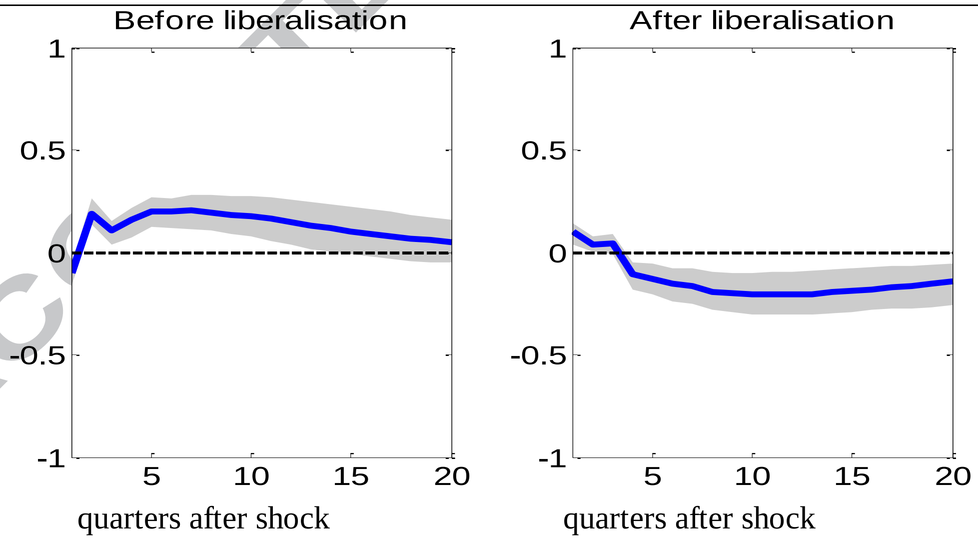
Appendix D. Robustness to triangular identification approach

Figure D.1: Impact of a monetary policy expansion - VAR model identified with lower-triangular restrictions



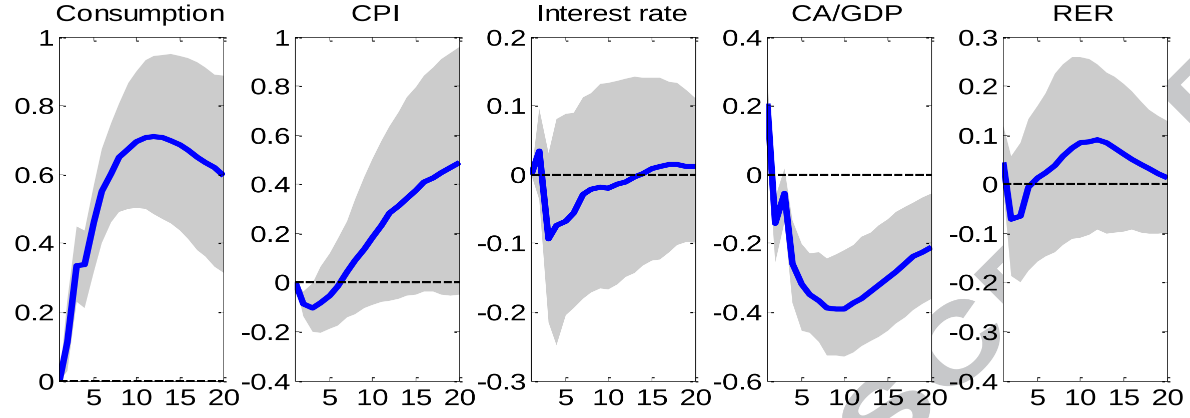
Note: Figure D.1 shows the transmission of an unexpected monetary policy expansion, identified with a triangular approach. It shows impulse responses, in percent, to a 100 basis point monetary policy expansion of real consumption, the CPI, the short interest rate, the current account to GDP ratio and the log of the real exchange rate. For the CPI, real consumption and the real exchange rate, cumulated impulse responses are shown, as these variables enter the model in log differences. It shows the responses when all of the exchange rate, financial, labour and product market indices have been evaluated at the sample medians. The median is the blue line and 68% quantiles, are reported in the grey area.

Figure D.2.a. CA/GDP following a monetary policy expansion before and after financial liberalisation - VAR model identified with lower-triangular restrictions



Note: Figure D.2.a shows the effect of financial liberalisation on the transmission of an unexpected monetary policy expansion to CA/GDP, identified with triangular restrictions. It shows the impulse response when all of the exchange rate, labour and product market indices have been evaluated at the sample medians, while the financial regulation measure is evaluated at the 10th and 90th percentiles respectively. The median is the blue line and 68% quantiles are reported in the grey area.

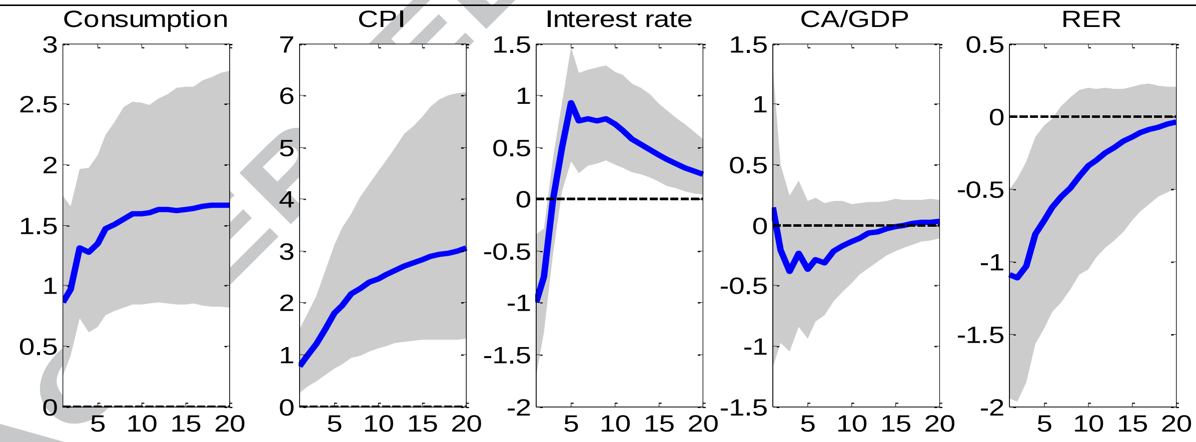
Figure D.2.b: The effect of financial market liberalisation on the monetary policy transmission mechanism – VAR model identified with lower-triangular restrictions



Note: Figure D.2.b shows the effect of financial market liberaliation on the transmission of an unexpected monetary policy expansion, identified with triangular restrictions. It shows the difference in impulse responses to a 100 basis point monetary policy expansion of real consumption, the CPI, the short interest rate, the current account to GDP ratio and the log of the real exchange rate. For the CPI, real consumption and the real exchange rate, cumulated impulse responses are shown, as these variables enter the model in log differences. The median is the blue line and 68% quantiles are reported in red.

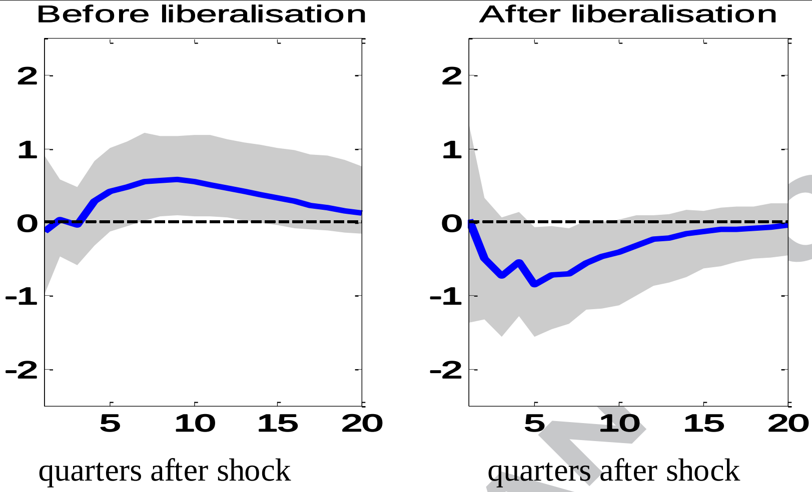
Appendix E. Robustness to year fixed effects

Figure E.1: Impact of a monetary policy expansion - VAR model with year fixed effects (identified using sign restrictions)



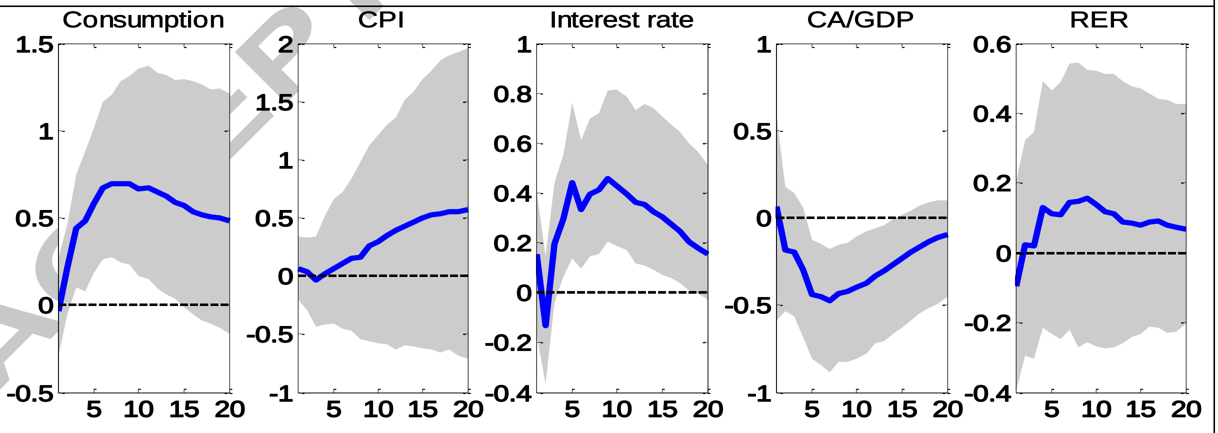
Note: Figure E.1 shows the transmission of an unexpected monetary expansion, identified with sign restrictions. It shows impulse responses, in percent, to a 100 basis point monetary expansion of real consumption, the CPI, the short interest rate, the current account to GDP ratio and the log of the real exchange rate. For the CPI, real consumption and the real exchange rate, cumulated impulse responses are shown, as these variables enter the model in log differences. It shows the responses when all of the exchange rate, financial, labour and product market indices have been evaluated at the sample medians. The median is the blue line and 68% quantiles, are reported in the grey area.

Figure E.2.a. CA/GDP following a monetary policy expansion before and after financial markets liberalisation - VAR model with year fixed effects (identified using sign restrictions)



Note: Figure E.2.a shows the effect of financial liberalisation on the transmission of an unexpected monetary policy expansion to CA/GDP, identified with sign restrictions. It shows the impulse response when all of the exchange rate, labour and product market indices have been evaluated at the sample medians, while the financial regulation measure is evaluated at the 10th and 90th percentiles respectively. The median is the blue line and 68% quantiles are reported in the grey area.

Figure E.2.b: The effect of financial market liberalisation on the monetary policy transmission mechanism – VAR model with year fixed effects (identified using sign restrictions)



Note: Figure E.2.b shows the effect of financial market liberaliation on the transmission of an unexpected monetary policy expansion, identified with sign restrictions. It shows the difference in impulse responses to a 100 basis point monetary policy expansion of real consumption, the CPI, the short interest rate, the current account to GDP ratio and the log of the real exchange rate between the low and high regulation cases. For the CPI, real consumption and the real exchange rate, cumulated impulse responses are shown, as these variables enter the model in log differences. The median is the blue line and 68% quantiles are reported in red.

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Highlights

- Past work is ambiguous as to the effect of monetary policy on the current account
- Theory suggests the outcome depends on the degree of financial regulation
- A VAR analysis of advanced economies confirms this
- With light regulation, monetary easing raises current account deficits